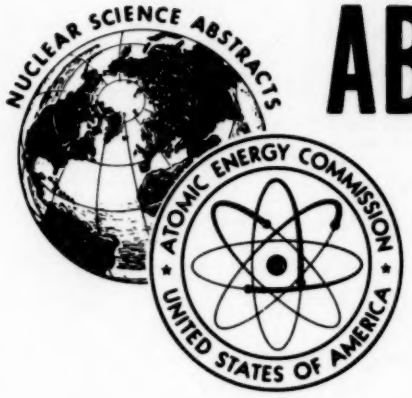
NUCLEAR SCIENCE ABSTRACTS



Volume 29 Number 11

Abstracts 26544-28960

June 15, 1974

UNITED STATES ATOMIC ENERGY COMMISSION

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Volume 29, Number 11, June 15, 1974

NUCLEAR SCIENCE ABSTRACTS

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Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

COX, S.H, DNA replication of induced prophage in Haemophilus influenzae, 28:18453
CRANDALL, J.L, Californium-252 neutron sources, 28:18415 (DP-MS-72-45)
CRAWFORD, J.F, Electron multiplication in cavities, 28:18990

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

REACTORS/RESEARCH PROGRAMS
Institute of Nuclear Research two-year-book, 1970--1971, 28:19902 (INR--1410)
RED DWARF STARS/STAR EVOLUTION
Perturbing aspects of the companions of Barnard's star, 28:19287
REFRACTORIES/ELECTRON MICROSCOPY
Electron microscope for investigation of metals at high temperature, 28:18834

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

19981 (ORNL-4804) ^{238}U NEUTRON ELASTIC-SCATTERING CROSS SECTIONS FROM 6.44 TO 8.56 MeV. Kinney, W. E.; Perey, F. G. **(Oak Ridge National Lab., Tenn.).** Jun 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
^{238}U neutron elastic-scattering cross sections from 6.44 to 8.56 MeV, 28:19981 (ORNL-4804)
Analytical techniques for determining levels and fates of trace elements in a fossil-fueled steam plant, 28:17850 (CONF-730817-1)

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Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

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Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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Volume 29, Number 11 June 15, 1974

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 26934, 28755, and 28813.

26544 (BARC-716) ANALYTICAL CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR 1972. Sankar Das, M.; Sathe, R. M. (comps.). (Bhabha Atomic Research Centre, Bombay (India)). 1973. 165p. Dep. NTIS (U.S. Sales Only) $10.25.

Twenty-four sections and subsections have been title listed and indexed separately for NSA. (LK)

For titles of individual sections see: 26546–26555, 26573–26582, 26613, 26614, 26703, and 26704.

26545 THERMAL DECOMPOSITION AND HYDROGENATION OF COAL DUST IN A SHOCK TUBE. Woodburn, E. T.; Everson, R. C.; Kirk, A. R. M. (Univ. of Natal, Durban, S. Afr.). Fuel; 53: No. 1, 38–46(Jan 1974).

A vertical shock tube with fluidized coal particles prior to shocking was used for this investigation. The high heating and quenching rates together with the exceedingly short reaction times obtainable with the shock tube were shown to have a marked effect on the product distribution. Additions of iodine were shown to promote the reaction. The reaction conditions were varied over the following ranges: shock temperature, 600 to 1200 K; maximum reaction time, 1.29 to 1.89 ms; pressures in shock, 658 to 1546 kPa. Electron photomicrographs of shocked coal particles are also presented. The distribution of gaseous hydrocarbons produced from coal subjected to high heating rates and short reaction times during hydrogenation is found to differ considerably from that produced by long reaction times, the gases containing a greater proportion of unsaturates (acetylene, ethylene, and propylene). The presence of gaseous iodine has no effect upon the product distribution of the hydrocarbon gases formed, but permits a lower reaction temperature for a given degree of decomposition. (auth)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 26662 and 26917.

26546 (BARC-716, pp 2-4) ESTIMATION OF URANIUM BY DELAYED NEUTRON COUNTING. Reddy, G. R.; Pant, D. R.; Sankar Das, M. 1973.

26547 (BARC-716, pp 5-6) NEUTRON ACTIVATION ANALYSIS OF LANTHANUM, SCANDIUM, AND COBALT IN DEEP SEA SEDIMENTS AND MANGANESE NODULES. Rao, B. L.; Pawaskar, P. B.; Reddy, G. R.; Sankar Das, M. 1973.

26548 (BARC-716, pp 6-8) ANALYTICAL APPLICATION OF CHARGED PARTICLE INDUCED NUCLEAR REACTIONS. Gangadharan, S.; Subramanian, S. Y. 1973.

26549 (BARC-716, pp 8-10) 14-MeV NEUTRON ACTIVATION. Gangadharan, S.; Subramanian, S. Y. 1973.

26550 (BARC-716, pp 10-11) ESTIMATION OF PARTS PER BILLION LEVELS OF COPPER IN DOUBLE DISTILLED WATER. Desai, H. B.; Iyer, R. K. 1973.

26551 (BARC-716, pp 12) ESTIMATION OF PLATINUM IN LEAD BUTTONS BY ACTIVATION ANALYSIS. Iyer, R. K.; Parthasarathy, R. 1973.

26552 (BARC-716, pp 12-13) ESTIMATION OF PHOSPHORUS IN TRIPHENYLCHLOROMETHANE BY NEUTRON ACTIVATION. Desai, H. B.; Iyer, R. K. 1973.

26553 (BARC-716, pp 14) DETERMINATION OF INDIVIDUAL RARE EARTHS. Desai, H. B.; Gangadharan, S.; Sankar Das, M. 1973.

26554 (BARC-716, pp 116-117) FORENSIC SCIENCE. Gangadharan, S.; Lakshmi, V. V.; Sankar Das, M.; Relan, G. R.; Singh, T. 1973.

26555 (BARC-716, pp 120) ION EXCHANGE RESINS AS STANDARDS FOR ACTIVATION ANALYSIS. Kayasth, S. R.; Iyer, R. K. 1973.

26556 (FRNC-TH-481) DEFINITION OF AN ARCHEOLOGICAL CERAMIC. Analysis After Neutron Activation Using the Monostandard Method. Delcroix, G. R. (Nancy-1 Univ., 54 (France)). 1973. 143p. (In French). Dep. NTIS (U. S. Sales Only) $10.25.

Thesis.

The analytical method used is presented: neutron activation using the monostandard method. This method involves determining the value of the flux, using an element which may or may not belong to the sample studied to monitor the flux; the other parameters are determined only once for all the measurements. A discussion is presented on the quantitative aspects of the distribution of elements in a ceramic found in a potters oven at Argentan and dated as belonging to the first half of the XIII century. (FR)

26557 (KFK-1889) ACTIVATION ANALYSIS WITH CHARGED PARTICLES: A PROGRAM FOR CALCULATING DETECTION LIMITS. Jaeger, U.; Muenzel, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Radiochemie). Dec 1973. 34p. (In German). Dep. NTIS (U. S. Sales Only) $4.75.

A program was developed, which calculates the detection limits in activation analysis, taking the influence of the matrix into account. The activities of the nuclides produced and the corresponding gamma spectra are computed. On the basis of these spectra the detection limit is calculated. (GE)

26558 (SLA-73-7024) DEPTH DISTRIBUTION PROFILING OF HYDROGEN. Langley, R. A.; Picraux, S. T.; Vook, F. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 6p. (CONF-740104-11). Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

A technique using nuclear microanalysis was developed to determine ^{2}D and ^{3}He concentration vs depth profiles in the near surface regions (≈ 2 μm) of solids. Ultimate near-surface depth resolutions of ~ 100 Å should be attainable by these techniques. A probing beam of ^{3}He ions is used to analyze for the deuterium. By energy analyzing the emitted ^{4}He ions from the reaction $^{3}He(d,p)^{4}He$ and simple computer analysis, deuterium concentration vs depth profiles are obtained. The same methods are applicable for ^{3}He profiling except in that case a ^{2}D probing beam is used. This technique is currently being developed using Er hydride and Sc hydride films. It is particularly suited for the study of the transition metals with high hydrogen solubility such as Nb and V which are of interest for CTR reactor applications. The analysis technique and preliminary results for multilayer hydride films are discussed. (auth)

26559 COMPLEXONES AS REAGENTS FOR SUBSTOICHIOMETRIC SEPARATION OF TRACE AMOUNTS OF ELEMENTS. Bilimovich, G. N.; Akol'zina, L. D.; Alimarin, I. P. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 12, 2417-2423(Dec 1973). (In Russian).

Isotope-dilution and radioactivation analysis methods using substoichiometric separation with complexones are examined. (auth)

26560 NEUTRON-ACTIVATION DETERMINATION OF IMPURITIES IN BORON COMPOUNDS OF SPECIAL PURITY (B_2O_3, H_3BO_3). Yankovskaya, T. A.; Lobanov, E. M.; Usmanova, M. M.; Sil'vanovich, Yu. A.; Popova, I. A. (Inst. of Nuclear Physics, Tashkent). Zh. Anal. Khim.; 28: No. 12, 2372-2377 (Dec 1973). (In Russian).

The self-shielding of targets has been studied by modelling the processes on artificial samples of H_3BO_3 and B_2O_3. Experimental values of the coefficient of shielding are given for samples of a regular geometric form (tablets) with a constant radius and the same material density. γ-Spectrometric and radiochemical methods are suggested for determination of Mg, Al, Cl, V, Mn, Fe, Co, Cu, Zn, Br, Pd, Ag, Ir, Pt, and Au microimpurities in special purity boron compounds H_3BO_3 and B_2O_3 with the sensitivity of $10^{-4}-10^{-8}$%. The mean square error is 10-25%. (auth)

26561 ACTIVATION ANALYSIS WITH NEUTRON GENERATORS. Nargolwalla, S. S.; Przybylowicz, E. P. Chemical Analysis, Volume 39. New York; John Wiley and Sons, Inc. (1973). 677p. $29.50.

Topics covered are: principles of the technique; production and interaction of fast neutrons; the neutron generator; radiation hazards and shielding considerations for neutron generator facilities; preparation and transportation of samples; sources and reduction of systematic error; and applications. The appendices contain: activation cross sections for D-T neutrons; calculated sensitivities for ≈15-MeV and thermal neutron activation analysis with a neutron generator, experimental sensitivities for 14.7-MeV and thermal activation analysis with a neutron generator; and experimental sensitivities for ≈3-MeV neutron activation analysis. (LK)

26562 DETERMINATION OF A GEOMETRY AND DEAD TIME CORRECTION FACTOR FOR NEUTRON ACTIVATION ANALYSIS. Hoffman, G. L. (Univ. of Rhode Island, Kingston); Walsh, P. R.; Doyle, M. P. Anal. Chem.; 46: No. 4, 492-496(Apr 1974).

A method is presented for an instrumental nondestructive determination of trace metals by thermal neutron activation analysis. The method involves determining a normalizing factor which relates the geometry and dead time between standard and sample. National Bureau of Standards certified orchard leaves and bovine liver were successfully analyzed by the method. The elements determined were Na, Mn, Cu, V, and Al. (auth)

26563 SUBSTOICHIOMETRIC EXTRACTION OF CATIONS WITH MIXTURES OF HEXAFLUOROACETYLACETONE AND TRI-N-OCTYLPHOSPHINE OXIDE IN CYCLOHEXANE. Mitchell, J. W. (Bell Telephone Labs., Inc., Murray Hill, NJ); Ganges, R. Anal. Chem.; 46: No. 4, 503-508(Apr 1974).

A new method was developed for substoichiometric extraction of cations by adduct reactions in the presence of excess hexafluoroacetylacetone (HHFA) and of substoichiometric quantities of the neutral donor, tri-n-octylphosphine oxide (TOPO), in cyclohexane. The equilibria of adduct extraction systems are discussed to show advantages over the conventional approach of reacting cations with substoichiometric amounts of chelating ligands. Distribution curves for the substoichiometric extraction of Co^{2+}, Cu^{2+}, Fe^{2+}, Mn^{2+}, Zn^{2+}, Fe^{3+}, Eu^{3+}, and Lu^{3+}, were measured, and experimental results with relative standard deviations of 0.92, 1.8, and 3.1% for the substoichiometric isolation of Zn^{2+}, Cu^{2+}, and Eu^{3+} are reported. The general utility of this extraction system for substoichiometric separation of cations following neutron activation is discussed. (auth)

26564 SENSITIVITIES FOR PHOTON ACTIVATION ANALYSIS WITH THICK-TARGET, 110-MeV ELECTRON BREMSSTRAHLUNG. Ricci, E. (Oak Ridge National Lab., TN). Anal. Chem.; 46: No. 4, 615-618(Apr 1974).

Experimental studies were conducted on the effects of the bremsstrahlung energy spectrum on photon activation analysis (PAA) sensitivities and interferences that result from the somewhat rigid operating conditions of the Oak Ridge Electron Linear Accelerator (ORELA). The electrons whose energy is seldom lowered below 100 MeV (for these studies, 105 to 140 MeV), are made to impinge on a massive (3.03 cm thick) tantalum target. In order to determine interference-free sensitivities for 16 elements, including Be, B, C, N, O, F, Na, Mg, Al, P, V, Ni, Cd, Sn, Ta, and Pb, the samples were bombarded at electron beam powers from 9.3 to 29.0 kW for 30 sec to 30 min. Radioactivity of the products was counted using a conventional γ spectrometer. The best sensitivities were obtained for C, N, O, and particully, F. Results generally agree with those, both experimental and calculated, of other authors. (JGB)

26565 DETERMINATION OF LEAD IN PAINT WITH FAST NEUTRONS FROM A CALIFORNIUM-252 SOURCE. Lutz, G. J. (National Bureau of Standards, Washington, DC). Anal. Chem.; 46: No. 4, 618-620(Apr 1974).

Interest in developing an economically competitive activation method for analysis of lead in paint prompted studies on the evaluation of a small ^{252}Cf source for this determination. The reaction $^{204}Pb(n,n')^{204m}Pb$ was studied first. All three γ lines of ^{204m}Pb were adequately resolved with a Ge(Li) detector, with no interference from other major or minor constituents. Results of studies on the $^{207}Pb(n,n')^{207m}Pb$ reactions were not as reliable as those with the ^{204m}Pb isotope. Results indicate that with a ^{252}Cf source of several tens of milligrams and the 60cm^3 Ge(Li) detector, the determination of ~1% of Pb in a sample of 1 to 2 grams of paint could be accomplished with a 15 min irradiation and 15 min counting. (JGB)

26566 QUANTITATIVE ANALYSIS OF Sb, Ag, Zn, Co, AND Fe IN HUMAN DENTAL CALCULUS BY NEUTRON ACTIVATION ANALYSIS AND HIGH-RESOLUTION GAMMA SPECTROMETRY. Retief, D. H.; Cleaton-Jones, P. E.; Turkstra, J.; Smit, H. J. J. Periodontal Res.; 8: 263-267(1973).

The sample to be analyzed and a standard of known composition were irradiated simultaneously in the poolside facility of a nuclear reactor for 130 hours in a thermal neutron flux of approximately 2×10^{13} n.cm^{-2}, sec^{-1}, and the induced radioactivity compared after a cooling period of four weeks. The investigation was done with a high resolution Ge(Li) detector coupled to a fully transistorized 4000 channel analyzer. The concentration of five elements, namely Sb, Ag, Zn, Co and Fe, was determined in human dental calculus by instrumental activation analysis and found to be 0.68, 0.18, 174, 0.08, and 54 ppM respectively. (auth)

26567 APPLICATION OF A LOW-FLUX SOURCE OF NEUTRONS TO ANALYSIS OF PRECIOUS METAL-CONCENTRATES. Ahmad, I.; Morris, D. F. C. (Brunel Univ., Uxbridge, Eng.). Radiochem. Radioanal. Lett.; 16: No. 6, 303-308(23 Mar 1974).

The possibility of using a small $^{241}Am-Be$ source of neutrons for the determination of silver, rhodium, iridium, and gold in precious metal-concentrates has been explored. (auth)

26568 DETERMINATION OF LIGHT ELEMENTS IN BIOLOGICAL SAMPLES BY PROMPT NUCLEAR REACTIONS. Demortier, G. (Univ. of Namur, Belgium). Radiochem. Radioanal. Lett.; 16: No. 6, 329-341(23 Mar 1974). (In French).

Analytical capabilities of direct nuclear reactions for elemental analysis of biological samples are explained, with application to quantitative and rapid analysis of B, N, F, Na and Mg. Analyses of heavier elements using proton inducing x-ray fluorescence are in progress. (auth)

26569 DETERMINATION OF THE TRACE ELEMENT LEVELS IN MARGARINE BY NONDESTRUCTIVE NEUTRON ACTIVATION ANALYSIS. Owlya, A.; Parsa, B.; Fakhrvaezi, F. (Univ. of Teheran). Radiochem. Radioanal. Lett.; 16: No. 6, 355-362 (23 Mar 1974).

By means of neutron activation analysis the concentration levels of trace elements in Iranian margarines were studied. A high resolution γ-spectrometer has been used to identify the radionuclides in irradiated "Shah-Passand" and "Ghoo" samples of margarines. A total of 13 elements at trace levels have been determined by this technique. They include Cl, Mn, Na, K, Br, La, Au, Cr, Fe, Cs, Sc, Zn, and Co. (auth)

26570 RADIOANALYTICAL INVESTIGATION ON DILUENT EFFECT ON THE EXTRACTION PLATINUM AND PALLADIUM CHLOROCOMPLEXES WITH TBP. Stella, R. (Univ., Pavia, Italy); Genova, N. Radiochem. Radioanal. Lett.; 16: No. 6, 273-282(23 Mar 1974).

The extraction of the chlorocomplexes of platinum and palladium with TBP in various diluents was investigated. Distribution ratios were determined by activation analysis. It was found that the proper choice of the diluent and of its concentration may markedly improve the separation of the two metals. (auth)

26571 DETERMINATION OF CHLORINE IN SUPPORTED RHODIUM CATALYSTS BY NEUTRON ACTIVATION ANALYSIS. Campbell, K. C. (Univ. of Glasgow); Reid, J. U.; Gibbons, D. Radiochem. Radioanal. Lett.; 16: No. 6, 283-287(23 Mar 1974).

Residual chlorine present in silica-supported rhodium catalysts, prepared from rhodium trichloride, has been determined by neutron activation analysis and γ spectrometry. (auth)

26572 EXCHANGE BEHAVIOR OF INORGANIC THALLIUM COMPOUNDS ON HYDRATED ANTIMONY PENTOXIDE (HAP). Furler, R.; Licht, I. E. C. P. M.; van Heijst, J. P. M. (Univ. of Amsterdam). Radiochem. Radioanal. Lett.; 16: No. 6, 323-328 (23 Mar 1974).

In the course of determining traces of noble metals in analytical grade and specpure inorganic thallium compounds by activation analysis it proved difficult to obtain a sufficiently high decontamination factor for the thallium matrix. One of the methods tried for matrix decontamination was the separation of thallium on hydrated antimony pentoxide. The exchange behavior of five inorganic thallium salts towards HAP was studied in six different media in column experiments. Single-step exchange appeared useful for the removal of bulk activity. Multi-step exchange permits analysis of traces in thallium compounds. (LK)

Chemical and Spectral Procedures

Refer also to abstracts 26739, 26854, and 26933.

26573 (BARC-716, pp 15-16) DETERMINATION OF CHLORIDE IN REACTOR GRADE SODIUM METAL. Bhat, N. P.; Sahasranaman, S.; Sundaresan, M. 1973.

26574 (BARC-716, pp 16-18) DETERMINATION OF TRACES OF FLUORIDE IN URANIUM METAL AND OXIDE. Ganapathy Iyer, S.; Parasurama Iyer, H.; Venkateswarlu, Ch. 1973.

26575 (BARC-716, pp 20-21) DETERMINATION OF GERMANIUM IN ZIRCONIUM ALLOYS. Kamath, V. A.; Iyer, C. S. P. 1973.

26576 (BARC-716, pp 21-22) DETERMINATION OF SULPHATE IN ZIRCONIUM OXIDE. Bajpai, H. N.; Iyer, C. S. P. 1973.

26577 (BARC-716, pp 23-24) SENSITIZATION OF NIOBIUM–BROMOPYROGALLOL RED SYSTEM BY CETYLTRIMETHYLAMMONIUM BROMIDE (CTAB). Billimoria, N. R.; Jadhav, S. G. 1973.

26578 (BARC-716, pp 25-26) DETERMINATION OF TRACES OF THORIUM IN URANIUM DIOXIDE AND URANIUM METAL. Joshi, M. Y. 1973.

26579 (BARC-716, pp 31-32) DETERMINATION OF IMPURITIES IN NUCLEAR GRADE SODIUM BY STRIPPING ANALYSIS. Khasgiwale, K. A.; Mehta, M. M.; Sundaresan, M. 1973.

26580 (BARC-716, pp 34-35) DETERMINATION OF COPPER AND MAGNESIUM IN Cu–Be–Mg ALLOYS BY COMPLEXOMETRY. Mahadevan, N.; Sathe, R. M. 1973.

26581 (BARC-716, pp 41-42) MIXED COMPLEXES OF Th^{4+}. Shetty, S. Y.; Sathe, R. M. 1973.

26582 (BARC-716, pp 90-91) CHRONOPOTENTIOMETRIC STUDIES IN FUSED SALTS–BEHAVIOUR OF THORIUM IN LITHIUM CHLORIDE–POTASSIUM CHLORIDE EUTECTIC. Khasgiwale, K. A.; Mehta, M. M.; Sundaresan, M.; Unnikrishnan, K. 1973.

26583 (HW-80365) MERCURY CATHODE CELL DESIGN FOR CONTROLLED POTENTIAL COULOMETRY. Scott, F. A. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 9 Jan 1964. Contract AT(45-1)-1350. 27p. Dep. NTIS $4.50.

A comparison has been made of the characteristics of several mercury-cathode cells for use in controlled potential coulometry for the determination of uranium. The investigation showed that completely rigid control of the potential is not needed to achieve reliable titrations, but that good determinations (less than 0.1% error) can be made with a cell which restricts potential overshoot to less than 10 mv. The new cell design, which provides adequate potential control, permits high titration speeds, and completely contains radioactive contamination, is presented. (auth)

26584 AMPEROMETRIC DETERMINATION OF Mo(VI) BY THE CATALYTIC CURRENT OF REDUCTION OF HYDROGEN PEROXIDE. Sharipova, N. S.; Songina, O. A. (Kazakh State Univ., Alma-Ata, USSR). Zh. Anal. Khim.; 28: No. 12, 2348-2351(Dec 1973). (In Russian).

A possibility has been shown of amperometric titration of molybdenum(VI) with lead(II) or complexone III in acetate buffer solutions by the catalytic current of reducing hydrogen peroxide on a mercury dropping electrode. The methods suggested were tested in the determination of molybdenum in molybdenite. (auth)

26585 ROLE OF A KINETIC FACTOR IN THE SUBSTOICHIOMETRIC DETERMINATION OF TRACE AMOUNT OF METALS. Stepanov, A. V.; Gedeonov, A. D. (Radium Inst., Leningrad). Zh. Anal. Khim.; 28: No. 12, 2302-2305(Dec 1973). (In Russian).

A possibility of substoichiometric analysis is conditioned by the kinetics of dissociation of complex ions of the metal to be determined. 1,2-Diaminecyclohexanetetraacetic acid is a convenient complex-forming substance for substoichiometric determination of traces of heavy rare earth metals in a comparatively acidic pH region. (auth)

26586 USE OF A HOLLOW CATHODE FOR THE ANALYSIS OF RADIOACTIVE SUBSTANCES. Zakharov, E. A.; Myasoedov, B. F.; Karyakin, A. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 12, 2306-2310 (Dec 1973). (In Russian).

The use of a hot hollow cathode enables simultaneous determination of impurity elements Zn, Cu, and Ni in dry solution residues containing microgram amounts of radioactive elements. It has been noted that the solution composition affects the limit of detection and precision. The burning has been shown to be most intensive for several first minutes of the discharge existence. (auth)

26587 INTERMOLECULAR AGGREGATION OF TRIARYLMETHANE DYES AND ITS ANALYTICAL IMPORTANCE. VII. Extraction-Photometric Determination of Iodine by Triphenylmethane dyes. Lomonosov, S. A.; Shukolyukov, N. I.; Chernoukhova, V. I. (All-Union Scientific-Research Inst. of Metrology, Sverdlovsk, USSR). Zh. Anal. Khim.; 28: No. 12, 2389-2395 (Dec 1973). (In Russian).

The effect of the nature, concentration of the reagents, and extraction conditions on an analytical reaction of molecular iodine with triphenylmethane dyes has been studied. An extraction-photometric method is suggested for determination of chlorine in air based on the interaction of iodine with crystalviolet in the presence of potassium iodide. (auth)

26588 MASS-SPECTROMETRIC DETERMINATION OF SURFACE CONTAMINATION. Bedrinov, V. P.; Belousov, V. I.; Khromova, N. V. Zh. Anal. Khim.; 28: No. 12, 2407-2412(Dec 1973). (In Russian).

A mass-spectrometric method has been developed for determination of the overall amount of surface contamination. The method accuracy has been estimated by the method added-found in the analysis of silicon plates and gallium arsenide. The content of impurity elements on the surface of silicon plates after special technological purification and conservation has been determined. (auth)

26589 CONCENTRATION OF MICROAMOUNTS OF ELEMENTS ON MIXED INORGANIC COLLECTORS IN THE SPECTRAL ANALYSIS OF NATURAL WATER. Lebedinskaya, M. P.; Chuiko, V. T. (Ternopol Medical Inst., USSR). Zh. Anal. Khim.; 28: No. 12, 2413-2416(Dec 1973). (In Russian).

A possibility has been shown of group concentration of microelements from natural water on mixed inorganic collectors consisting of phosphates and hydroxides of multivalent metals (Fe^{3+} and Mg^{2+}) at pH 10–12 and concentration of 5–45 μg/l. Under such conditions 80–85% W, 85–90% Nb, 90–95% Ba, 100% Cu, Zn, Pb, Bi, Co, Ni, Be, V, As, Mo and Cd are precipitated. A chemical-spectral method has been worked out for determining the elements with the sensitivity of 1.10^{-7}–1.10^{-3}%. The enrichment coefficient is 14300. The coefficient of variation is between 1 and 8% for the concentration used. (auth)

26590 ANALYSIS OF NUCLEAR RAW MATERIALS. III. Spectrophotometric Determination of Thorium in Yellow Cake Samples and Uranium-Containing Minerals After Separation by Anion Exchange. Korkisch, J.; Dimitriadis, D. (Univ., Vienna). Mikrochim. Acta; No. 1, 25-38(Jan 1974). (In German).

A method is described for the separation of μg amounts of thorium from large amounts of foreign ions. The separation of the thorium is accomplished by adsorption on a column made of the strongly basic anion exchanger Dowex 1-X8 (nitrate form) from 8M nitric acid solution, whereby the thorium is separated from practically all elements. After the removal of the accompanying elements, the thorium is eluted with 6M hydrochloric acid, the eluate is boiled down and the organic substances that arise from the exchange resin and are contained in the thorium-bearing boiling-down residue are destroyed by means of potassium permanganate. Then the thorium is determined spectrophotometri-

cally by means of the thoronol- or the arzenazo III method. Prior to applying the arsenazo III method, it is essential to destroy the nitrate ions by means of formic acid. The method was employed for determining thorium in the region of approximately 1 to 100 ppm, and in fact for the analysis of Yellow Cake samples (0.8 to 1.5 ppm thorium), minerals containing uranium (0.5 to 15 ppm Th), IAEA-standard specimens and geological standards (0.7 to 100 ppm). A good agreement of the results was obtained both when the Thoronol and also when the Arsenazo III method were employed. (auth)

26591 SPECTROPHOTOMETRIC DETERMINATION OF URANIUM WITH 1-[(5-METHYL-2-PYRIDYL)AZO]-2-NAPHTHOL. Shibata, S.; Furukawa, M.; Ishiguro, Y. (Government Industrial Research Inst., Nagoya, Japan). Mikrochim. Acta; No. 1, 129-133(Jan 1974).

Uranium(VI) reacts with 1-[(5-methyl-2-pyridyl)azo]-2-naphthol (5-Me-β-PAN) in aqueous solution. The complex can be extracted with chloroform at pH 7.0–11.5 to give a red solution with an absorbance peak at 560 nm. The color is stable and the system conforms to Beer's law at the range of 1.5–8 ppm uranium in chloroform layer. Common anions and cations do not interfere. Large amounts of interfering cations can be masked by potassium cyanide, EDTA or triethanolamine. The proposed method is a selective procedure for the determination of uranium. The molar absorptivity in the chloroform extract is 2.1×10^4 l mole^{-1} cm^{-1} at 560 nm. (auth)

26592 DETERMINATION OF FREE SILICON IN DISILICIDES OF THE TRANSITION METALS OF GROUPS IV-VI. Kopylova, V. P.; Nazarchuk, T. N. (Inst. of Problems of Material Science, Kiev). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 3, 355-357 (Mar 1973).

Translated from Zavod. Lab.; 39: No. 3, 257-259(Mar 1973).

The interaction of Ti, Zr, Hf, V, Nb, Cr, Ta, Mo, and W disilicides with a 1% solution of NaOH was studied, and a method was developed for determining free silicon in the disilicide. The method involved dissolution of the disilicide in NaOH and determination of silicon by photometry. (LK)

26593 KINETIC METHOD OF DETERMINING NICKEL IMPURITIES IN TANTALUM AND NIOBIUM PENTOXIDE (EXCHANGE OF EXPERIENCE). Dolmanova, I. F.; Zolotova, G. A.; Voronina, R. D.; Peshkova, V. M. (Moscow State Univ.). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 3, 386-387(Mar 1973).

Translated from Zavod. Lab.; 39: No. 3, 281-282(Mar 1973).

Nickel impurities in tanta Ta_2O_5 and Nb_2O_5 were determined by a kinetic method using catalytic oxidation of the diphenylcarbazone by hydrogen peroxide. Under the experimental conditions, 2.7×10^{-4} and 2×10^{-4}% nickel was found in 0.1 g samples of Ta_2O_5 and Nb_2O_5, respectively. (LK)

26594 NEW SPECTROMETRIC TECHNIQUES FOR REAL-TIME ANALYSIS OF ISOTOPIC MIXTURES. Davies, J. H.; Nor, J. K. Technical Meeting No. 4/13. Basel; Nuclex (1972). 15p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Two-line spectroscopy was applied to analysis of liquid mixtures of H_2O and D_2O, and correlation spectroscopy was applied to the same species in their vapor phase. (LK)

26595 USE OF ^{197}Hg FOR MASS INVENTORY OF CHLORINE CELLS. Bendel, D.; Heywood, E. F.; McCartney, R. N. (Royal Melbourne Inst. of Tech.). At. Energy Aust.; 16: No. 4, 27-29 (Oct 1973).

A procedure is described for the mass determination of mercury in electrolytic cells used for the production of chlorine. A standard isotope dilution test is used whereby the background of the mercury in each cell is determined, an aliquot of ^{197}Hg added, thorough mixing allowed, and samples then counted to determine the mass in each cell. Special techniques are described to obtain the desired accuracy. (AT)

26596 CONTRIBUTION TO THE DETERMINATION OF SOME ANIONS VIA TITRATION WITH A LEAD(II) NITRATE SOLUTION USING HETEROCYCLIC AZO DYES AS INDICATORS. Sommer, L.; Janoscova, L. (Pyrkyne Univ., Brno). Collect. Czech. Chem. Commun.; 39: No. 1, 101-109(Jan 1974).

The determination of molybdate, phosphate, tungstate, and sulfate via titration with lead(II) nitrate, using 4-(2-pyridylazo)resorcinol, 4-(2-thiazolylazo)resorcinol, 2-(2-thiazolylazo)-4-methoxyphenol, and 2-(2-pyridylazo)-1-naphthol-4-sulphonic acid as indicators, was studied and the precision, accuracy, and applicability of the individual methods were evaluated. (auth)

26597 POLAROGRAPHIC PROCEDURES WITHOUT REMOVAL OF OXYGEN, AND OTHER APPROACHES TO MAKING THE DETERMINATIONS MORE RAPIDLY. Bond, A. M. (Univ. of Melbourne). Talanta; 20: No. 11, 1139-1152(Nov 1973).

One disadvantage of conventional d.c. polarography as an analytical method has always been its relative slowness. The possibility of simplifying and speeding up analyses by avoiding the necessity for removal of oxygen is demonstrated under suitable conditions with current-sampled d.c., pulse and a.c. polarography. In particular it is shown that high-frequency phase-selective a.c. polarography gives considerable discrimination against the oxygen electrode process in some aqueous media. Under these conditions, the high-frequency a.c. technique can be combined with the method of short drop-time, fast scan-rate rapid a.c. polarography to provide a most attractive method of routine analysis. Among the elements which can be determined by this method are the following: In, Cd, U, Cs. Polarographic analysis in non-aqueous media without removal of oxygen is also discussed. (auth)

26598 POTENTIOMETRIC TITRATION OF IODINE BY A THIOSULFATE SOLUTION IN NON-AQUEOUS MEDIA AND STUDY OF THE FORMATION OF I_3^- COMPLEX ION. Ramadan, A. A.; Agasyan, P. K.; Petrov, S. I. (Moscow State Univ.). Zh. Anal. Khim.; 28: No. 12, 2396-2401(Dec 1973). (In Russian).

The interaction of iodine with $Na_2S_2O_3$ in acetone, methyl, ethyl (96%), isopropyl and tert-butyl alcohol media has been studied potentiometrically. The interaction is fast, stoichiometric and quantitative in all the solvents used. An additional bend is observed on the buffer part of the curves of the potentiometric titration of iodine with $Na_2S_2O_3$ in all alcohols studied. The bend is conditioned by the formation of a triiodide complex and a difference between $E^0_{I_2}$ and $E^0_{I_3^-/I^-}$ values. The magnitude of lg K_{form} for the I_3^- complex in 96% ethanol has been calculated by spectrophotometric data to be 4.70 ± 0.01. The stability of the I_3^- complex in different solvents, found by the first bend position on the potentiometric titration curves, follows the order: methanol > ethanol (96%) > isopropanol > tert. butanol > acetone, water. (auth)

26599 EXTRACTION–PHOTOMETRIC METHOD OF DETERMINING MOLYBDENUM IN THIN MAGNETIC FILMS. Ivanova, I. F.; Bukhteeva, L. N.; Ganago, L. I.; Gribkovskaya, L. G.; Yurii, L. N. (Inst. of Solid-State and Semiconductor Physics, Minsk). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 4, 531-532 (Apr 1973).

Translated from Zavod. Lab.; 39: No. 4, 388-390(Apr 1973).

A method for determination of molybdenum in thin magnetic films is based on the interaction of a molybdenum thiocyanate complex with crystal violet. The complex is extracted into an alcohol-toluene solution and the molybdenum is determined photometrically. This method is used for analyzing Fe–Ni–Mo films. (LK)

26600 POLAROGRAPHIC DETERMINATION OF EUROPIUM IN COMPLEX TUNGSTATES AND MOLYBDATES. Pavel'eva, O. Kh.; Milyavskii, Yu. S. (Inst. of Radioengineering and Electronics, Moscow). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 4, 537-541(Apr 1973).

Translated from Zavod. Lab., 39: No. 4, 393-394(Apr 1973).

Additives of europium in crystals of (K, Na, Li)-yttrium tungstates and molybdates were determined by a polarographic method. The interfering action of molybdenum was eliminated by the use of an ammonia background, and yttrium was retained in solution with complexone III. (LK)

26601 DETERMINATION OF FREE CARBON IN METALLIC BERYLLIUM. Evseeva, T. I.; Cherstvenkova, E. P.; Nikol'skii, V. A.; Denisova, V. I. Ind. Lab. (USSR) (Engl Transl.); 39: No. 4, 542-544(Apr 1973).

Translated from Zavod. Lab.; 39: No. 4, 397-400(Apr 1973).

A method developed for the direct determination of free carbon in metallic beryllium involves combustion of a weighed sample of material at 900 ± 50°C for 8-10 min, followed by chromatographic measurement of the liberated carbon dioxide. (LK)

26602 PHOTOMETRIC DETERMINATION OF ZIRCONIUM IN NICKEL-BASE ALLOYS. Il'ina, L. I. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 4, 560(Apr 1973).

Translated from Zavod. Lab.; 39: No. 4, 410(Apr 1973).

Development of a photometric method with the reagent xylenol orange, based on the formation of a red-colored complex in 0.4 N sulfuric acid, for the determination of 0.005 to 0.3% zirconium in nickel alloys containing tungsten, niobium, and titanium is reported. (LK)

26603 DETERMINATION OF MICROQUANTITIES OF ZIRCONIUM AND HAFNIUM BY THE METHOD OF PAPER CHROMATOGRAPHY. (Exchange of Experience). Fedorova, N. E.; Stepanova, N. P.; Eiger, V. I. (Rostov State Univ., USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 4, 561-562(Apr 1973).

Translated from Zavod. Lab.; 39: No. 4, 411(Apr 1973).

Optimum conditions for separation of small quantities of zirconium and hafnium by partition paper chromatography were determined and a photometric method for determination of these elements in the zones of the chromatograms with arsenazo III was developed. (LK)

26604 SPECTRAL ANALYSIS OF ZIRCONIUM AND DISTHENE CONCENTRATES BY MEANS OF THE SPILL METHOD. Efimenko, N. I.; Kushnaeva, V. N. (Verkhnedneprovskii Mining-Metallurgical Combine, USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 4, 586-588(Apr 1973).

Translated from Zavod. Lab.; 39: No. 4, 430-432(Apr 1973).

USA-5 spectral equipment is used in the spill method. The operating principle consists of applying a powdered sample pulverized to 200 mesh into an arc discharge. Zirconium and disthene concentrates were analyzed with an analysis error of 5 to 6%. (LK)

26605 INVESTIGATION OF CONDITIONS OF THE PHOTOMETRIC DETERMINATION OF NIOBIUM WITH 5-(2-THIAZOLYLAZO)-2-MONOETHYLAMINO-P-CRESOL. Mal'tseva, L. S.; Elinson, S. V. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 4, 527-530(Apr 1973).

Translated from Zavod. Lab.; 39: No. 4, 385-388(Apr 1973).

The azo compound 5-(2-thiazolylazo)-2-monoethylamino-p-cresol (TAAC) was investigated as a means of determining niobium by spectrophotometry. TAAC was also used to determine niobium in alloys containing uranium, molybdenum, and zirconium. (LK)

26606 DETERMINATION OF THE RARE EARTH ELEMENTS OF THE CERIUM SUBGROUP BY DIFFERENTIAL-SPECTROPHOTOMETRIC METHODS. Akhmedli, M. K.; Ayubova, A. M.; Babaeva, T. R. (Azerbaidzhan State Univ., USSR). Azerb. Khim. Zh.; No. 3, 93-96(1973). (In Russian).

A new differential-spectrophotometric method was developed for the determination of large quantities of the rare earth elements of the Ce subgroup. The method is applied to the analysis of monazite, loparite, and mixtures of rare earth oxides. (tr-auth)

26607 VIDICON TUBE AS A DETECTOR FOR MULTIELEMENT FLAME SPECTROMETRIC ANALYSIS. Busch, K. W.; Howell, N. G.; Morrison, G. H. (Cornell Univ., Ithaca, NY). Anal. Chem.; 46: No. 4, 575-581(Apr 1974).

An instrument for multielement flame emission analysis is described which consists of a 0.5m Ebert monochromator, a silicon diode vidicon tube, and an optical multichannel analyzer. Optical and electronic considerations of the system are discussed. Using this system, a spectral "window" of 20 nm is monitored simultaneously and atomic lines 1.4 A apart are resolvable. Detection limits, obtained under compromise flame conditions, are presented for Mo, Fe, Ca, Al, Ti, W, Mn, and K using spectral lines present in a single window. The multielement analysis of a geological standard rock sample for Fe, Ca, Al, and Ti is described, and the results are compared with the accepted values. Other potential windows for multielement analysis are presented. (auth)

26608 QUANTITATIVE DYE LASER AMPLIFIED ABSORPTION SPECTROMETRY. Spiker, R. C. Jr.; Shirk, J. S. (Illinois Inst. of Tech., Chicago). Anal. Chem.; 46: No. 4, 572-574(Apr 1974).

If the sample is included inside the optical cavity of a broad band organic dye laser, it is possible to use weak absorptions for quantitative analysis. For Ho^{3+} and Pr^{3+} solutions in the range 5×10^{-3} to 10^{-4} M with optical densities in the range ~0.005 to ~0.0001, the laser intensity is related empirically to the sample concentration. The method can be used for gases and for atomic absorptions as well as for solutions. The sensitivity of the technique may be increased several orders of magnitude. (auth)

26609 TRACE DETERMINATION OF BERYLLIUM OXIDE IN BIOLOGICAL SAMPLES BY ELECTRON-CAPTURE GAS CHROMATOGRAPHY. Frame, G. M. (Air Force Systems Command, Wright-Patterson AFB, OH); Ford, R. E.; Scribner, W. G.; Ctvrtnicek, T. Anal. Chem.; 46: No. 4, 534-539(Apr 1974).

Two preparations of beryllium oxide labeled with ^7Be were synthesized by calcining at 500°C or 1600°C. Comparative radiochemical and gas chromatographic analyses of these oxides were made using two procedures. Direct dissolution–chelation of the oxides with concentrated trifluoroacetylacetone in ampoules followed by electron-capture gas chromatography of the resultant beryllium chelate suffered from interference by a trifluoroacetylacetone reaction product. A second method employed the dissolution of the oxides in dog blood and rat liver homogenate media by a hot 75% sodium hydroxide procedure. The beryllium from the dissolved oxide was then chelated by a low temperature reaction with trifluoroacetylacetone without forming an interfering product. Subsequent gas chromatographic analysis yielded recoveries averaging 105%; standard deviation = ±7%. The samples tested were limited to the 1.0-mg BeO/ml level by radioactivity, but the gas chromatographic base-line noise level was low enough to permit analyses of submicrogram quantities. (auth)

26610 SPECTROCHEMICAL COMPUTER ANALYSIS: PROGRAM DESCRIPTION. Walthall, F. G. J. Res. U. S. Geol. Surv.; 2: No. 1, 61-71(1974).

The computerized system of spectral analysis performs determinations of 68 elements in geologic materials. The elements include Be, Ce, Cs, Dy, Er, Eu, Gd, Ho, La, Lu, Mo, Nb, Nd, Ru, Sc, Sm, Sr, Tb, Te, Th, Tm, U, Y, Yb, and Zr. The samples are arced under carefully controlled conditions in an argon–oxygen atmosphere and the spectra are exposed on 102- by 508-mm (4- by 20-inch) plates. Transmittance readings taken every 5 μm along the spectrum are recorded on magnetic tape, producing more than 90,000 readings in 70 sec. The computer program described examines the data, searches for a maximum of 500 spectral lines, and after treating the results prints concentrations for the elements on a report form. The plates are calibrated every 250 A, transmittances are converted to intensities, backgrounds are subtracted, interferences are recognized, and one final answer for each element. Concentrations are obtained from analytical curves prepared prior to the sample run. Samples are run under the same carefully controlled conditions that were used to prepare the analytical curves. (auth)

26611 TERNARY COMPLEXES OF RARE EARTH ELEMENTS WITH PYROGALLIC RED AND DIPHENYLGUANADINE (DPG) AND THEIR USE FOR EXTRACTION-SPECTROPHOTOMETRIC DETERMINATION OF RARE EARTH ELEMENTS IN MINERAL WATERS. Kirillov, A. I.; Makarenko, O. P.; Vlasov, N. A. (Irkutsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol. 16: No. 8, 1150-1153(1973). (In Russian).

The analysis is carried out by putting 25 ml of natural water, and 25 ml samples of rare earth aliquots containing 0.6 and 1.2 μg/ml of rare earth in three calibrated flasks. Then additions of 6 ml of pyrogallic red (1×10^{-3} molar) and of 3 ml of diphenylguanidine (0.1 molar) are made, and the pH of the solution is adjusted to 7.0 by adding ammonia–ammonium acetate as a buffer. The rare earth complex is then extracted with 10 ml of butyl alcohol, and the optical density is measured on a spectrophotometer at 660 mm. Maximum extraction of the complex is observed at a pH of 7. The distribution coefficient is equal to 247, and the percent extraction is 99. The sensitivity is 0.12 μg/ml for rare earths, and the determination accuracy is 2 to 5%. The solution of rare earth complex obeys Beer's law in the range of rare earth concentrations of 1.2 to 160 micrograms of rare earths in the 10 ml of n-butanol. The ions UO_2^{2+}, Al^{3+}, Fe^{2+}, Fe^{3+}, Sc^{3+} and Th^{4+} have the greatest effect on the extraction of the rare earth complex. (SJR)

26612 COMPARATIVE SPECTROPHOTOMETRIC DETERMINATION OF THORIUM IN MONAZITE AND POLYRITE WITH THE USE OF SULFOPHTHALEINS. Argisheva, A. I.; Cherkesov, A. I. (Saratov Pedagogical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 8, 1160-1162(1973). (In Russian).

This study uses the following reagents for the spectrophotometric determination of thorium in monazite and polyrite. Thymol–sulfophthalein–S (Reagent I), which is the sodium salt of 3,3'-bis-N,N'-di(carboxymethyl)aminomethylthymosulfophthalein, sulfophthalein–S (Reagent II), which is [3,3' -bis-N,N' -di (carboxymethyl)aminomethylphenolsulfophthalein], and o-cresolsulfophthalein-s (Reagent 3). The color of the thorium complex develops immediately and is stable with time. The optimum acidity is at a pH of 2. Calibration curves of Reagents I, II and III for thorium are prepared by placing 0.5, 0.75, 1.0, 1.25, 1.5 and 1.75 ml of Th (5×10^{-4} M) in a 25 ml flask, and adding 2.5 ml of the complexing agent (5×10^{-4} M), 10 ml of acetate buffer at pH of 2, and making up to 25 ml with water. The optical density is measured in a cuvette with l = 10 mm. It was found that Reagent III (0-cresolsulfophthalein-s) was more accurate and sensitive than the other two reagents in determining thorium in monazite and polyrite. The allowable ratios of thorium to interfering metal ions Th : Me were as follows: La-1 : 500; U-1 : 1000; Ce and Co-1 : 100; Nd-1 : 400; Gd-1 : 50; Pb-1 : 800; Cd-1 : 300; Mn-1 : 200; and Cr-1 : 20. Small amounts of Fe^{3+}, Ga, Sc, Zr, PO_4^{3-}, $C_2O_4^{2-}$ and WO_4^{2-} interfere with the analysis. (SJR)

Radiometric and Radiochemical Procedures

26613 (BARC-716, pp 1-2) ISOTOPIC ANALYSIS OF URANIUM BY ALPHA SPECTROMETRY. Rao, B. L.; Parekh, P. P.; Reddy, G. R.; Sankar Das, M. 1973.

26614 (BARC-716, pp 11-12) ESTIMATION OF MERCURY IN LEAD AND ZINC CONCENTRATES AND IN 1-AMINOANTHRAQUINONE. Desai, H. B.; Iyer, R. K.; Kayasth, S. R. 1973.

26615 (RT/CHI-(73)11) RADIOCHEMICAL PROBLEMS RELATED TO POST-IRRADIATION ANALYSES OF FUEL ELEMENTS. Cesarano, C.; Marangio, G.; Naticchioni, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 29 Nov 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

Present and future needs in the radiochemical work at the Casaccia Hot Laboratory are evaluated in view of the most modern trends in analytical methods, developed to determine isotope ratios, burnup, and fission product distribution. Several properly equipped, α-tight boxes will be constructed. Two types of analytical procedures are anticipated, the first related to the daily post-irradiation requirements, the second directed toward more specialized analyses in order to achieve a more detailed knowledge of the behavior of fuel elements under irradiation. (auth)

26616 RADIOMETRIC DETERMINATION OF MICROGRAM AMOUNTS OF CHLORIDE IN WATER. Vilenskii, V. D.; Koroleva, N. I. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 12, 2381-2383(Dec 1973). (In Russian).

A simple radiometric method is suggested for determination of chloride in natural water with the sensitivity of 0.036 μg/ml. The standard deviation is about 10% for a chloride concentration range of 0.14–3.0 μg/ml and 20% for a range of 0.07–0.14 μg/ml. (auth)

26617 ELEMENTAL ANALYSIS OF WHOLE BLOOD USING PROTON-INDUCED X-RAY EMISSION. Bearse, R. C.; Close, D. A.; Malanify, J. J.; Umberger, C. J. (Los Alamos Scientific Lab., NM). Anal. Chem.; 46: No. 4, 499-503(Apr 1974).

A technique for the analysis of trace elements in whole blood was developed using proton-induced x-ray emission. Samples of 0.1 ml whole blood from humans and mice were dried, weighed, and then ashed in a plasma asher. Targets were prepared by placing drops made from the ash and a 400-ppM Pd solution onto Formvar backings. The samples were irradiated with 2.25-MeV protons, and the x-rays analyzed in a nondispersive x-ray detector. The elements Fe, Cu, Zn, Se, and Rb were detected with a precision of 7, 18, 7, 50, and 19%, respectively, in human whole blood. The precision of the technique was determined by statistical analyses of two different sets of 27 samples. The system was found to be linear for variations in elemental concentration. The accuracy for determination of Zn was found to be within 10% by comparison to atomic absorption spectrometry. (auth)

26618 IMPROVED TRITIUM COUNTING THROUGH HIGH ELECTROLYTIC ENRICHMENT. Theodorsson, P. (Univ. of Iceland, Reykjavik). Int. J. Appl. Radiat. Isotop.; 25: No. 3, 97-104(Mar 1974).

The sensitivity of the measurements of tritium in natural water has been increased by using a volume reduction factor as high as 300 in a single-stage electrolytic enrichment instead of a factor of 10 to 20 as normally used. By continuously filling the electrolysis cell from a reservoir a reduction factor of 1500 can be attained in a single stage. Using this technique the simple Geiger counter gives all the desired sensitivity for hydrological studies. A comparison of the present measuring technique with the more important alternative methods is given. (auth)

Separation Procedures

Refer also to abstract 26750.

26619 (FRNC-TH-439) STUDY OF LIQUID–LIQUID EXTRACTION FROM MOLTEN ALKALI NITRATES AND FROM NITRIC SOLUTIONS USING PHOSPHORAMIDES. Gonnet, C. (Lyon-1 Univ., 69 (France)). 1972. 101p. (In French). Dep. NTIS (U. S. Sales Only) $8.25.

Thesis.

The phosphoramides (particularly hexamethylphosphorotriamide) are well known for their complexing agent and solvent qualities. These properties are due to the basicity of the PO phosphoryl group which gives a high dipole moment to the molecule and an enhanced complex forming potential. In the first part of these studies, the extracting power of hexamethylphosphorotriamide (HMPT) and hexabutylphosphorotriamide (HBPT) from a molten nitrate medium was investigated. The extracting power was tested with CoII. The extraction of rare earths and their separation were then studied. The effect of temperature on the separation process was examined. In the second part of these studies, the liquid-liquid extraction of metals from aqueous phases by phosphoramides was investigated. The behavior of HBPT in the chosen system (water and nitric acid extraction) was examined. The distribution of rare earth elements was then studied. (FR)

26620 (RFP-Trans-148) EXTRACTION OF PYROPHOSPHATE ACIDO COMPLEXES OF URANIUM, ZINC, AND RARE-EARTH ELEMENTS BY ALKYLAMINES WITHOUT DILUENTS. Shevchuk, I. A.; Tarasenko, L. Ye.; Chayka, V. D.; Paliy, A. I.; Drobysheva, V. P. Translated from Ukr. Khim. Zh.; 38: 817-818(1972). 2p. Dep. NTIS $3.00.

The extraction of pyrophosphate acidocomplexes of U, Zn, and the rare earths was effected with molten fractions of the primary alkylamines C_{17} to C_{20} and with liquid fractions of the primary alkylamines C_{10} to C_{12} without the use of a diluent. The possibility of extracting pyrophosphate complexes of metals by alkylamines in an alkaline medium was demonstrated. (tr-auth)

26621 EXTRACTION OF CERTAIN ELEMENTS BY FUNCTIONALLY SUBSTITUTED POLYPHOSPHORIC ORGANIC COMPOUNDS. Lukashenkova, N. V.; Fadeeva, V. I.; Bol'shova, T. A. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 6, 690-692(1973). (In Russian).

The extraction of gallium, indium, zirconium, and scandium from hydrochloric acid solutions by some bifunctional phosphoric organic compounds was studied. Gallium and zirconium were found to be extracted selectively by phosphinate II. The possibility of extractive separation of gallium and indium, zirconium and scandium was demonstrated. (auth)

26622 MIXED SOLVENTS IN ION-EXCHANGE CHROMATOGRAPHY FOR SEPARATION OF BERYLLIUM FROM SOME ELEMENTS. Belyavskaya, T. A.; Nemirovskaya, I. A. (Moscow State Univ.). Zh. Anal. Khim.; 28: No. 12, 2337-2339(Dec 1973). (In Russian).

Aqueous-acetone solutions of HCl have been used for chromatographic separation of beryllium on the KU-2 × 8 resin in the H-form. Quantitative procedures have been worked out for separation of beryllium from some elements at their ratios Be : Cu = 1 : 1000, Be : Ni = 1 : 100 and 100 : 1, Be : Mg = 1 : 100, Be : Zn = 1 : 10,000. (auth)

26623 SOLVENT EXTRACTION OF TRIVALENT TRANSPLUTONIUM ELEMENTS WITH 1-PHENYL-3-METHYL-4-BENZOYLPYRAZOLONE-5 AND EFFECT OF TRIOCTYLPHOSPHINE OXIDE ON THEIR SEPARATION FACTORS. Chmutova, M. K.; Pribylova, G. A.; Myasoedov, B. F. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 12, 2340-2343(Dec 1973). (In Russian).

The extraction of Am, Cm, Bk, and Cf with benzene solutions of 1-phenyl-3-methyl-4-benzoylpyrazolone-5 (PMBP) has been studied. The elements are extracted as $MeA_3 \cdot HA$. A synergistic effect is observed when trioctylphosphine oxide is added. The effect follows the order: Am < Cm < Bk < Cf. The separation factors decrease in the presence of triocytylphosphine oxide. (auth)

26624 EXTRACTION OF URANIUM(IV) FROM SULFURIC ACID BY TRIOCTYLAMINE IN BENZENE. Juznic, K.; Fedina, S. (Inst. Jozef Stefan, Ljubljana, Yugoslavia). Mikrochim. Acta; No. 1, 39-44(Jan 1974).

The extraction of U(IV) from aqueous sulfuric acid media by TOA in benzene has been studied as a function of the sulfuric acid concentration and the concentration of TOA in the organic phase. The extraction may be represented by an equation such as

$$H_2U(SO_4)_3 + (R_3NH)_2SO_4 = (R_3NH)_2U(SO_4)_3 + H_2SO_4$$

The results for extraction from mixtures of U(VI) and U(IV) suggest that U(VI) forms a much more stable complex with TOA. Osmometric measurements on solutions of the U(IV)-complex in the organic phase indicate a tendency of this complex to aggregate. (auth)

26625 THERMODYNAMICS OF LIQUID–LIQUID DISTRIBUTION REACTIONS. I. The Dioxouranium(VI) Nitrate-Water-Tri-n-Butyl Phosphate-n-Dodecane System. Marcus, Y.; Kolarik, Z. (Kernforschungszentrum, Karlsruhe, Ger.). J. Chem. Eng. Data; 18: No. 2, 155-163(Apr 1973).

The heat effect of the extraction of uranyl nitrate from aqueous solution into TBP has been measured. The measurements include both forward and back extractions with neat TBP at 23 ± 1°C, extractions with TBP in dodecane at 23 ± 1°C, and extractions with

neat TBP at 5 to 40°C. Heats of mixing of TBP and of uranyl nitrate bis(TBP) solvate with dodecane, which are endothermic, the heat of dilution of aqueous uranyl nitrate, and the heat of hydration of TBP were also measured. The thermodynamic functions for the extraction reaction UO_2^{2+} (aq) + $2NO_3^-$ (aq) + 2 TBP(org) = $UO_2(NO_3)_2(TBP)_2$(org) were calculated. The standard state (aq) for the aqueous phase is infinite dilution of all solutes in water. For the organic phase, two distinct standard states (org) are used: infinite dilution of all solutes in dodecane (marked by °) and infinite dilution of all solutes in hydrated TBP (marked by *). The standard state functions are, in kJ mol^{-1}: $\Delta H^* = -54.5$, $\Delta H^\circ = -33.8$, $\Delta G^* = -45.6$, $\Delta G^\circ = -41.0$, and in J K^{-1} mol^{-1}: $\Delta S^* = -30$, $\Delta S^\circ = +24$, and $\Delta C_p^\circ = +405$. (auth)

26626 THIN-LAYER CHROMATOGRAPHIC SEPARATION OF ZIRCONIUM, HAFNIUM, THORIUM, URANIUM, AND THE RARE EARTHS OF DEAE-CELLULOSE IN SULFATE MEDIA. Shimizu, T.; Muto, A. (Gunma Univ., Maebashi, Japan). J. Chromatogr.; 88: No. 2, 351-355(30 Jan 1974).

The thin-layer chromatographic behavior on DEAE-cellulose in H_2SO_4–$(NH_4)_2SO_4$ media was investigated in detail for Hf(IV), Zr(IV), U(VI), Th(IV) and the trivalent rare earths and the work is described in this paper. Procedures were developed for the separation of Zr(IV) and Hf(IV), and for the two-dimensional separation of Zr(IV), Hf(IV), Th(IV), U(VI) and the trivalent rare earths. (JSR)

26627 DISTRIBUTION COEFFICIENTS OF 52 ELEMENTS ON A STRONGLY BASIC ANION-EXCHANGE RESIN IN AQUEOUS SOLUTIONS OF ORTHOPHOSPHORIC ACID. Polkowska-Motrenko, H.; Dybczynski, R. (Inst. of Nuclear Research, Warsaw). J. Chromatogr.; 88: No. 2, 387-390(30 Jan 1974).

Preliminary results of the systematic determination of the distribution coefficients of 52 elements on Dowex 1-X8 resin in H_3PO_4 solutions at concentrations from 0.1 to 14 M at room temperature are reported. Adsorbabilities of elements show marked differences even for elements in the same group of the Periodic Table. With few exceptions the distribution coefficients decrease proportionally with increase in acid concentration. The elements can be divided into three groups: those that show no or low adsorbability over the entire acid concentration range; those that have distribution coefficients with values from tens to a few hundreds at low H_3PO_4 concentrations; and those that have high adsorbability with distribution coefficients of the order of 500 or more in dilute H_3PO_4 solutions. (JSR)

26628 SORPTION PROPERTIES OF CERIUM PHOSPHATE AND ARSENATE ION EXCHANGERS. Zsinka, L.; Szirtes, L. (Inst. of Isotopes, Budapest). Radiochem. Radioanal. Lett.; 16: No. 5, 271-278(15 Feb 1974).

Sorption properties of crystalline cerium phosphate and arsenate ion exchange materials were investigated in case of alkaline metals in HCl and NH_4Cl solutions at various concentrations. At low ion concentration the $Na^+ < K^+ < Rb^+ < Cs^+$ and at high ion concentration the reverse sorption orders were found. No difference was found between the D-values for the metals when they were alone or together in the investigated systems. The results show that the cerium phosphate has somewhat higher selectivity than cerium arsenate. (auth)

26629 SOLVENT EXTRACTION OF Nd, Eu, Gd, Yb, Th, Pa, AND Np IN THE FORM OF THENOYLTRIFLUOROACETONATES FROM MOLTEN ALKALINE NITRATES. Foos, J.; Guillaumont, R. (Univ., Paris). Radiochem. Radioanal. Lett.; 16: No. 6, 315-321 (23 Mar 1974). (In French).

Solvent extraction of Nd, Eu, Gd, Yb, Th, Pa and Np at 150° from a molten $LiNO_3/KNO_3$(½) eutecic by TTA in a polyphenyl mixture has been studied. Discussion about partition of solvated cations and plots of the log distribution coefficients of these elements versus log free TTA concentration in the organic phase are reported. (auth)

26630 AMERICIUM RECOVERY FROM REDUCTION RESIDUES. Conner, W. V.; Proctor, S. G. (to United States Atomic Energy Commission). US Patent 3,781,404. 25 Dec 1973. Filed date 18 May 1972. 4p.

A process for separation and recovery of americium values from container or "bomb" reduction residues comprising dissolving the residues in a suitable acid, adjusting the hydrogen ion concentration to a desired level by adding a base, precipitating the americium as americium oxalate by adding oxalic acid, digesting the solution, separating the precipitate, and thereafter calcining the americium oxalate precipitate to form americium oxide. (Official Gazette)

26631 SORPTION OF PLUTONIUM, AMERICIUM, AND CURIUM ON ION-EXCHANGE RESINS IN MIXED WATER–ALCOHOL SOLUTIONS. Haidvogel, N.; Reitsamer, G.; Grass, F. (Univ., Vienna). Atomkernenergie; 22: No. 9, 117-127(Oct 1973). (In German).

The sorption of sulfate and nitrate complexes of the actinides Pu(III), Pu(IV), Pu(VI), Am(III) and Cm(III) on the ion-exchange-resins Dowex 1X8 and Dowex 50 WX8 was investigated. The strong sorbability of these actinide ions in solvents with high content of alcohol is explained by the existence of anionic complexes like $Pu(III)(SO_4)_2^-$, $Pu(IV)(SO_4)_5^{3-}$, $Pu(VIO_2(SO_4)_3^{3-}$, $Am(SO_4)_2^-$, $Cm(SO_4)_2^-$ on $Am(NO_3)_4^-$ and $Cm(NO_3)_4^-$. The taking of autoradiographs from the thin-layer chromatograms by the aid of a special device and the evaluation of the autoradiographs by a particular photodensitometer are described. The measurements of the radioactivity of the α-emitting nuclides Pu 239, Am 241, and Cm 242 are done by liquid-scintillation spectrometry. (GE)

26632 ION-EXCHANGE PROPERTIES OF A NUMBER OF ARSENIC AND ZIRCONIUM COMPOUNDS. Chernorukov, N. G.; Korshunov, I. A.; Shuklina, N. P. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 8, 1287-1288(1973). (In Russian).

A study was made of a characteristic amorphous zirconium arsenate ion-exchanger having hydroxyl and arsenate groups with a composition $Zr(OH)_{3.4}(HASO_4)_{1.7} \cdot 1.85\ H_2O$, and of a crystalline zirconium arsenate with the composition $Zr(HASO_4)_3 \cdot H_2O$. The exchange capacity was determined as a function of solution pH. The amorphous compound behaves similarly to a weak-acid cation exchanger with an exchange capacity of 4.6 mg-equiv/g for Li^+, Na^+, K^+ and Rb^+. For NH_4^+ and Cs^+ there is a significant deviation between the theoretical capacity and the total absorption capacity. For the amorphous compound the selectivity series runs: $Cs^+ > Rb^+ > K^+ > NH_4^+ > Na^+ > Li^+$. The crystalline zirconium arsenate has a layer lattice structure, and does not adsorb Cs^+, while Rb^+ is limitedly adsorbed. The absorption of NH_4^+, Li^+, Na^+ and K^+ follows ion-exchange, and corresponds to a theoretical capacity of 5.1 mg-equiv/g. The selectivity series runs as follows: $K^+ > Na^+ > Li^+ > NH_4^+ \gg Rb^+ \gg Cs^+$. The crystalline zirconium arsenate is a highly selective ion-exchanger, and can be used to separate alkali metal impurities from cesium salt solutions. (SJR)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 27329 and 28668.

26633 THERMODYNAMIC PROPERTIES OF $3La_2O_3 \cdot WO_3$ AT HIGH TEMPERATURES. Chentsov, V. N.; Skolis, Yu. Ya.; Levitskii, V. A.; Khekimov, Yu. (Moscow State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 9, 1414-1417(Sep 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 9, 1591-1595(Sep 1973).

The emf at 1200–1450°K of the oxygen concentration cell Pt/La_2O_3, W, $3La_2O_3 \cdot WO_3/O^{2-}/Fe_{0.95}O$, Fe/Pt was measured. For the reaction $3La_2O_3 + W + \frac{1}{2}\ O_2 \rightarrow 3La_2O_3 \cdot WO_3$ in this temperature range, ΔG (±510) cal = −240530 (±1720) + 53.93 (±1.34) T was obtained. The thermodynamic parameters of the formation reaction of $3La_2O_3 \cdot WO_3$ from the oxides and elements were obtained. (auth)

26634 EFFECT OF B_2O_3 ON THERMAL TRANSFORMATION OF ALUMINOPHOSPHATE BINDER. Tikavyi, V. F.; Korpus, V. A.; Chivenkov, A. N.; Lapko, K. N. (Belorussian State Univ., Minsk). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 9, 1430-1432(Sep 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 9, 1608-1610(Sep 1973).

Addition of B_2O_3 to aluminophosphate binder (APB) leads to amorphization of the initial compositions. The acid products of dehydration of APB are less stable, and the formation of condensed aluminum phosphates is observed at lower temperatures, than in the case of pure APB. The reaction of B_2O_3 with APB leads to formation of BPO_4, $AlPO_4$, (cristobalite), and an X-phase. (auth)

26635 THERMODYNAMIC INVESTIGATION OF THE POSSIBILITY OF FORMATION OF OXYSULFIDES OF Y, La, AND Ce. Soshchin, N. P. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 9, 1350-1353(Sep 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 9, 1516-1519(Sep 1973).

The possibility of obtaining individually pure oxysulfides was

assessed on the basis of the analytically determined values of the heats of formation, entropy, and Gibbs free energy of formation of Y_2O_2S, La_2O_2S, and Ce_2O_2S. The advantage of sulfiding the initial oxides by alkali metal sulfides or chlorine-containing sulfiding agents is shown. (3 tables) (auth)

26636 X-RAY INVESTIGATION OF HYDRATED Rb AND Cs TETRAFLUOROURANYLATES. Mikhailov, Yu. N.; Udobenko, A. A.; Kuznetsov, V. G.; Shchelokov, R. N.; Davidovich, R. L. (Inst. of General and Inorganic Analysis, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 9, 1387-1390(Sep 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 9, 1560-1563(Sep 1973).

Preliminary x-ray structural investigation was made of crystals of monohydrate of rubidium and cesium tetrafluorouranylates. Symmetry, lattice constants, and space groups were determined. Synthesis of $Cs_2UO_2F_4 \cdot H_2O$ is described and thermographic data of this compound are given. (auth)

Isotope Effects

Refer also to abstract 26701.

26637 AROMATIC REACTIVITY. Part 55. Solvent Isotope Effects in the Base Cleavage of Aryltrimethylstannanes in Methanol: Evidence for Electrophilic Assistance by the Solvent. Alexander, R.; Asomaning, W. A.; Eaborn, C.; Jenkins, I. D.; Walton, D. R. M. (Sussex Univ., Brighton, Eng.). J. Chem. Soc., Perkin Trans., II; No. 3, 304-308(1974).

Values of the product isotope effects, corresponding to the product ratios XC_6H_5/XC_6H_4D obtained in 1:1 MeOH–MeOD mixtures for cleavage of $X \cdot C_6H_4 \cdot SnMe_3$ compounds by sodium methoxide in methanol at 21°C, have been found to be as follows: (X =) p-OMe, 5.2; p-Me, 5.1; H, 4.9; m-OMe, 4.9; p-Cl, 4.5; m-CF_3, 4.3; p-NO_2, 3.8. For the compounds with X = p-OMe and m-CF_3 values of 2.45 and 2.00 for the overall solvent effects, $(k_{MeOH}/k_{MeOD})_S$, have been determined by measurement of the separate rates at 50° in MeOH and in MeOD. Proton transfer from the solvent to the carbon atom of the Sn-aryl bond is involved in the rate-determining step, which is probably the conversion of the Sn^V intermediate $(MeO)Me_3Sn^- \cdot C_6H_4 \cdot X$ into the Wheland-intermediate $(MeO)Me_3Sn^- \cdot C_6H_5^+ \cdot X$. (auth)

26638 THERMAL CONDUCTIVITY OF HEAVY OXYGEN-18 WATER. Bibik, A. P.; Litvinenko, I. V.; Radchenko, I. V. (Dnepropetrovsk Metallurgical Inst., USSR). Inzh.-Fiz. Zh.; 26: No. 1, 42-45(Jan 1974). (In Russian).

The ratio of thermal conductivity of heavy ^{18}O water with different concentration to that of ordinary water is measured by the transient hot-wire null-method at unsteady thermal conditions from 0 to 40°C. The data are extrapolated for 100% concentration. The thermal conductivity of 100% ^{18}O water is calculated and it is found to be by 6.4% less than thermal conductivity of ordinary water, having practically the same temperature coefficients. The difference between thermal conductivity of ^{18}O and deuterium waters and discrepancy with the theory of Horrocks, McLaughlin and Ubbelohde [3] are pointed out. (auth)

26639 RADIATIONLESS TRANSITIONS IN SOLUTIONS: ISOTOPE AND PROXIMITY EFFECTS ON Dy^{3+} BY C–H and C–N BONDS. Haas, Y.; Stein, G.; Wuerzberg, E. (Hebrew Univ., Jerusalem). J. Chem. Phys.; 60: No. 1, 258-263(1 Jan 1974).

The lifetime and quantum yield of fluorescence from the $^4F_{\frac{9}{2}}$ level of Dy^{3+} have been measured in perprotonated and perdeuterated dimethylsulfoxide and methylcyanide under various excitation conditions. The results are compared to those obtained in light and heavy water and with other rare earth ions and discussed with reference to the modified energy gap law in the theory of radiationless transitions. The specific energy gap in Dy^{3+} is such that efficiency of quenching depends on matching the electronic energy gap of the ion by a single vibration of C–H, C–D, or C–N and on the distance of the bond from the ion. (auth)

26640 MECHANISM OF THE TRIMERIZATION OF ACETYLENE. Chukhadzhyan, G. A.; Abramyan, Zh. I.; Gevorkyan, G. A. J. Gen. Chem. USSR (Engl. Transl.); 43: No. 9, 1998-2001(Sep 1973).

Translated from Zh. Obshch. Khim.; 43: No. 9, 2012-2016(Sep 1973).

The trimerization of acetylene in presence of $(TPP)_4Ni$ goes with a considerable kinetic isotopic effect. The ratio $k_{C_2H_2}/k_{C_2D_2}$ is 2.3. The formal kinetics of the conversion of acetylene and of acetylene-d_2 over $(\pi\text{-allyl})_2Ni$ were studied. The ratio $k_{C_2H_2}/k_{C_2D_2}$ = 3.2. The ethynyl complex of nickel, which was isolated and characterized, is an intermediary in the trimerization of acetylene. A scheme is proposed for the trimerization of acetylene under the influence of NAA–TIBA in homogeneous media. (tr-auth)

26641 EFFECTS OF VARIATIONS IN REACTION COORDINATE EIGENVALUE ON HEAVY-ATOM KINETIC ISOTOPE EFFECTS: EIGENVECTORS CONSISTING OF ONE AND TWO NONZERO ELEMENTS. Kidd, R. W.; Yankwich, P. E. (Univ. of Illinois, Urbana). J. Chem. Phys.; 59: No. 5, 2723-2737(1 Sep 1973).

The pentatomic formic acid molecule is used as a model for the survey of the influence on calculated heavy atom kinetic isotope effects of curvature of the potential energy surface ($\nu_1^\ddagger = 0 - 8001\ cm^{-1}$) along the reaction coordinate at the transition state. Restrictions employed are: invariant geometry and basis diagonal force field; light species reaction coordinate eigenvector consisting of one or two nonzero elements only. The temperature independent factor TIF = $(\nu_i^\ddagger/\nu_i^{\ddagger\prime})$ in the rate constant ratio k/k' generally falls as $\nu_i^\ddagger$ is increased, but the effect is small. The effect for two-element reaction coordinates of this restricted type is likely the largest such, therefore the influence of barrier curvature on $\nu_i^\ddagger/\nu_i^{\ddagger\prime}$ is negligible for practical reaction modeling purposes. The remaining part of k/k', the temperature dependent factor TDF, arising in isotopic shifts of genuine vibrations, can be strongly affected by barrier curvature. In a few cases, TDF rises slightly as $\nu_i^\ddagger$ is increased; usually it falls, sometimes so rapidly that the sign of $\ln(k/k')$ is reversed. Since $\nu_i^\ddagger$ is not an experimental variable, its significance to reaction modeling lies in the fact that graphs of $\ln(k/k')$ vs $(1/T)$ for various reaction coordinates with various $\nu_i^\ddagger$ do not often intersect at large angles; adjustment of $\nu_i^\ddagger$ can therefore assist in reducing the redundancy of results of calculations based on a variety of models being compared with experimental results. The barrier curvature and reaction coordinate complexity problem are discussed in terms of the first-order high temperature approximation, "cut-off procedures," and other approaches to the simplification and rationalization of ab initio calculations of kinetic isotope effects. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstracts 26699 and 27162.

26642 (BNWL-B-326) PARAMETRIC STUDIES OF TRITIUM SEPARATION CASCADES. Interim Report. Lester, D. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1974. Contract AT(45-1)-1830. 59p. Dep. NTIS $5.45.

Computer programs are now in place which can be used to calculate parametric effects in ideal cascade separations of tritium-hydrogen. Calculations of total flow and separative duty were made as a function of decontamination factors and enrichment factors for a range of separation constants (α's). Summary results for all cases calculated are included. Plant shapes (head-to-product flow ratios versus stage number) were also calculated. In addition, an initial investigation of the simultaneous separation of naturally occurring deuterium was carried out. The deuterium calculations are done assuming that an ideal cascade for tritium is also ideal for deuterium at the same time (i.e., constant heads separation factor, equal concentrations for both streams fed to a stage. The results show that the total flow (which is indicative of cascade power consumption) for tritium-hydrogen changes very rapidly with separation constant, from >3000 to about 200 moles/mole feed for a separation constant less than 2 for decontamination factors (DF) between 10^4 and 10^8. The change in total flow with separation factor is very small for separation factors above 2. Total flow at a given enrichment factor is relatively insensitive to feed concentration from 4×10^{-11} to 1×10^{-6}. A dramatic difference is observed between the effect of DF and the effect of enrichment factor or plant shape. A change in DF at a given enrichment factor results in a reduction of the number of stripping stages with no change in the recycle ratios of the plant. A change in enrichment factor for a given DF has an overall, large impact on plant shape and size. Increasing enrichment factors results in large increase of pumping and capital costs, while DF mainly affects capital costs. A check on the assumptions used for deuterium predictions indicates that the assumption is not very accurate. More sophisticated handling of H, D, T is indicated. Preliminary conclusions indicate that unless there is great advantage to producing tritiated D_2O, high enrichment factors are not recommended because of high capital and operating expense. A maximum enrichment factor of 10^2 is indicated. Large DF's do not instill large penalties in plant design; 10^6 or 10^8 may not be unreasonable. Incremental increases of separation constants above ≈5 result in rapidly diminishing incremental decreases of the number of stages (capital cost) and in the total flow (operation cost). (JGB)

26643 (MLM-2118) MOUND LABORATORY ACTIVITIES FOR THE DIVISION OF PHYSICAL RESEARCH: JULY–DECEMBER 1973. Hauenstein, M. F. (ed.). (Mound Lab., Miamisburg, Ohio (USA)). 28 Feb 1974. Contract AT(33-1)-Gen-53. 46p. Dep. NTIS $4.00.

Separate abstracts were prepared for the six sections of this report. (LK)

For abstracts of individual sections see: 26644–26647, 26756, and 27302.

26644 (MLM-2118, pp 9) CARBON ISOTOPE SEPARATION. 28 Feb 1974.

In Mound Laboratory activities for the Division of Physical Research: July–December 1973.

During this report period, the two-column carbon monoxide distillation system produced 330 g of CO with a ^{13}CO concentration of 90%. The $BaCO_3$ conversion system produced 630.827 g of $BaCO_3$ (99.9% ^{12}C) and 1794 g of $BaCO_3$ (90% ^{13}C). (LK)

26645 (MLM-2118, pp 10-12) STABLE ISOTOPE SEPARATION. 28 Feb 1974.

In Mound Laboratory activities for the Division of Physical Research: July–December 1973.

The following stable isotopes were separated: ^{37}Ar, ^{78}Kr, ^{21}Ne, and ^{124}Xe. (LK)

26646 (MLM-2118, pp 13-25) SEPARATION RESEARCH. 28 Feb 1974.

In Mound Laboratory activities for the Division of Physical Research: July–December 1973.

Progress is reported in the following areas of separation research: molecular beam scattering, thermal diffusion factor of xenon isotopes and of He-Kr and He-Xe mixtures, liquid thermal diffusion, and calcium isotope exchange. (LK)

26647 (MLM-2118, pp 26-32) LOW TEMPERATURE RESEARCH. 28 Feb 1974.

In Mound Laboratory activities for the Division of Physical Research: July–December 1973.

Analysis of the neon vapor pressure ratio data has been completed. The hydrogen isotope distillation system was modified, and H_2, HD, and D_2 were separated into a top and bottom product that contained <0.21% D_2 and 0.03% H_2, respectively. (LK)

26648 STABLE ISOTOPE ENRICHMENT BY THERMAL DIFFUSION, CHEMICAL EXCHANGE, AND DISTILLATION. Schwind, R. A.; Rutherford, W. M. (Monsanto Research Corp., Miamisburg, OH). pp 255-266 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

The enrichment of several stable isotopes of medical interest by gas and liquid thermal diffusion, chemical exchange and distillation is described. These isotopes are prepared as labeled compounds with either the stable isotope itself, such as ^{13}C, or with the radioactive isotope that can be produced by irradiating the stable isotope, such as the irradiation of ^{124}Xe to produce ^{125}I. Engineering advances have improved the applicability of gas thermal diffusion to separate litre quantities of the isotopes of the noble gases. The gas thermal diffusion equipment and present enrichment capabilities at Mound Laboratory are described for the noble gases with emphasis on the isotopes of xenon and krypton. Current developmental work on the use of liquid thermal diffusion is also described. Improved performance has been obtained by precise construction of the thermal diffusion columns. Liquid thermal diffusion is applicable to several stable isotopes, and the method is currently being developed for the isotopes of sulphur, chlorine and bromine. Typical separation data for sulphur isotope enrichment are presented. Chemical exchange processes are being investigated at Mound Laboratory for the enrichment of stable isotopes. Both gas-liquid and liquid-liquid chemical exchange methods are potentially applicable to stable isotope separation. Isotopes of medical interest which may be enriched by chemical exchange methods include the isotopes of carbon, sulfur, and various metal isotopes. Chemical exchange offers the possibility of various metal isotopes being made available at unit prices significantly lower than the current prices. The last stable isotope enrichment method is that of distillation. Chemical exchange and distillation have been used for the enrichment of ^{13}C. However, the cryogenic distillation of carbon monoxide is the best process for enriching either ^{13}C or ^{12}C. Currently kilogram quantities of ^{13}C and ^{12}C are available from Mound Laboratory. (auth)

26649 KINETIC TREATMENT OF PHOTOCHEMICALLY INDUCED ISOTOPIC EXCHANGE. Levy, A. (Israel Atomic Energy Commission, Beersheba); Meyerstein, D.; Ottolenghi, M. Int. J. Appl. Radiat. Isotop.; 25: No. 1, 9-14(Jan 1974).

A kinetic treatment describing the time dependence of the exchanged fraction (F) is presented for the photochemically-induced isotopic exchange process: $AX + BX^* \xrightarrow{h\nu} AX^* + BX$ when complicated by a net change in the concentration of AX due to the side reaction: $AX \xrightarrow{h\nu} BX$. The kinetic equations are numerically integrated and applied to the specific case in which AX = iodobenzene and BX* is radioactive iodine ($I^{131}I$). The treatment accounts quantitatively for the experimental F vs. time plots. It also leads to the evaluation of the relative rate constants of the phenyl radical (Ph·) scavenging processes: $Ph\cdot + I_2 \rightarrow PhI + I\cdot$ and $Ph\cdot + S \rightarrow$ scavenging products where S is benzene, toluene or molecular oxygen. (auth)

26650 ISOTOPE FRACTIONATION OF ^{15}N AND ^{14}N IN MICROBIOLOGICAL NITROGEN TRANSFORMATIONS: A THEORETICAL MODEL. Focht, D. D. (Univ. of California, Riverside). J. Environ. Qual.; 2: No. 2, 247-252(1973).

The kinetics for first-order multisequence reactions are derived for microbial fractionation of ^{14}N and ^{15}N isotopes. The isotope effect accounts for unreacted substrate becoming progressively enriched in the heavier isotope due to preferential utilization of the lighter isotope by microorganisms. Consequently, during denitrification nitrate becomes enriched in ^{15}N as its concentration diminishes. This inverse proportional relationship is expressed as a hyperbolic function, $Y = ax^{-b}$. Similar curves are derived for nitrate originating from ammonification and/or nitrification. Regression coefficients for a straight line approximation are better than −0.98, but not as good as the actual coefficients for the derived hyperbolic equations. A negative regression "line" for nitrate occurs for all denitrification reactions during isotope discrimination. Nitrate originating from casein, ammonium, and nitrate are respectively less enriched in ^{15}N for equal nitrate concentration due to ammonium and nitrate being initially enriched in ^{14}N during ammonification and nitrification, respectively. (auth)

Feed Materials Processing

Refer also to abstract 26823.

26651 (IEA-292) AMINE EXTRACTION OF URANIUM, MOLYBDENUM, AND VANADIUM FROM ACID LEACH LIQUORS. Floh, B.; Abrao, A.; Calmon Costa, E. (Instituto de Energia Atomica, Sao Paulo (Brazil)). May 1973. 17p. (CONF-700836-1). Dep. NTIS (U. S. Sales Only) $4.00.

From symposium on the recovery of uranium; Sao Paulo, Brazil (17 Aug 1970).

Several alternative schemes were evaluated for the extraction and separation of the uranium, molybdenum and vanadium values of sulfuric acid leach liquors. The work was conducted in connection with the development of an acid leaching process for the uranium-molybdenum ore from the Pocos de Caldas plateau in the State of Minas Gerais. Extraction conditions for uranium were established from data obtained from pure solutions and extrapolated to the leach liquors after investigation of effects in binary and ternary solutions. The establishment of optimized extraction conditions in pure solutions employed a sequential graphic optimization approach. (auth)

26652 INVESTIGATIONS ON THE BACTERIAL LEACHING OF URANIUM ORES. Ebner, H. G. (Dortmund Univ., Ger.); Schwartz, W. Erzmetall; 26: No. 10, 484-490(Oct 1973). (In German).

Basic principles of the process of bacterial leaching are covered. Experiments with uranium ores from deposits in the FRG, using varieties of the thiobacillus, are described. Experimental results and optimization of leaching conditions are discussed. Another method combining chemical and microbiological leaching is described. (GE)

Radiation Chemistry

Refer also to abstracts 26696, 26702, 26751, 26752, and 26770.

26653 (COO-2364-1) MECHANISMS FOR RADIATION DAMAGE IN DNA. Progress Report, June 1, 1973–May 31, 1974. Sevilla, M. D. (Oakland Univ., Rochester, Mich. (USA)). 1974. Contract AT(11-1)-2364. 32p. Dep. NTIS $3.75.

A mechanism has been proposed for radiation damage to DNA and a series of experiments detailed utilizing electron spin resonance spectrometry to test the proposed mechanism. Thus far we have produced and investigated the positive and

negative ions of a number of purine and pyrimidine DNA bases in aqueous glasses. The g values and hyperfine couplings, both anisotropic and isotropic, have been determined when possible. The 5-methyl substituted pyrimidine cations (thymine, thymidine, 5-methylcytosine and 5-methylcytidine) react in these aqueous systems by deprotonation of the 5-methyl group. The thymine anion has been found to protonate in neutral aqueous glasses. Investigations of the cation and anion radicals of the other DNA bases have shown a lessened tendency toward further reaction. In related work the reactions of electrons with 5-halouracils as well as amino acids and peptides were studied. In work with 5-halouracils we have isolated the anions, found their relative stability, and followed their further reactions. Results were in agreement with those of other experimental methods. (auth)

26654 (FRNC-TH-463) GAMMA RADIOLYSIS OF HEXANE AND HEXANE–CARBON TETRACHLORIDE MIXTURES. Oksman, B. (Toulouse-3 Univ., 31 (France)). 1973. 80p. (In French). Dep. NTIS (U. S. Sales Only) $7.00.

Thesis.

Gas-phase chromatography was used to study the γ radiolysis of hexane, and hexane-carbon tetrachloride mixtures in the 0.5 to 5.5 Mrad range. The chemical yields do not vary significantly with the dose. The results obtained were interpreted for hydrogen, hexenes, dodecanes, and chlorinated products. The scavenging power of CCl_4 was established together with the solvent–solute energy transfer characteristics. The behavior of charged species after their thermalization is discussed and the common points between radiolysis and measurements of radiation-induced conductivities brought to notice. (FR)

26655 (FRNC-TH-471) EFFECT OF γ RADIATION ON URACIL AND URIDYLIC ACID IN AERATED AQUEOUS SOLUTION. Ducolomb, R. (Grenoble-1 Univ., 38 (France)). 1972. 117p. (In French). Dep. NTIS (U. S. Sales Only) $9.00.

Thesis.

In the first part of this thesis, an aerated aqueous uracil solution exposed to γ radiation was studied. Eleven radiolysis products were identified. The spectral properties (IR, NMR, and mass spectrometry) of these substances are described and discussed. Chromatographic separation techniques were developed for separating these often unstable products under favorable conditions. Intermediate radiolysis products (hydroxyhydroperoxides) were prepared and identified. Studies of the degradation kinetics of uracil and the G value for the radiolysis products enabled the amounts of these substances produced to be established. The decay scheme for the radiolysis substances was determined. Up until now, it was believed that the principal products resulted from a saturation of the 5-6 double bond of the pyrimidine cycle. It was shown that this is not the only mechanism occurring and that there is also an opening of the pyrimidine cycle. In the second part of this thesis, the principal products produced by the rupturing of the N-glycosidic bond of uridylic acid were identified. (FR)

26656 (ORNL-TM-4426, pp 129-131) PULSE RADIOLYSIS. Hochanadel, C. J. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22–23, 1973.

Two molecules studied were: O_2, where formation of O_3 after the pulse was observed, and NO, where formation of NO_2 was observed during the pulse and formation of N_2O_3 was observed shortly after the pulse as it establishes equilibrium with NO_2 and NO. Rate constants for reactions of HO_2, OH, and $O(^1D)$ were measured. (LK)

26657 CONFORMING TRANSITIONS IN RADICALS IN γ-IRRADIATED ADDUCTS OF UREA WITH ESTERS AND NITRILES OF CARBOXYLIC ACID. Kuleshov, A. P.; Trofimov, V. I.; Chzheidze, I. I. (Inst. of Chemical Physics, Moscow). Zh. Strukt. Khim.; 14: No. 5, 820-825(1973). (In Russian).

By EPR methods radicals in γ irradiated compounds from the incorporation of a series of esters and nitriles of carboxylic acid with urea were investigated. Changes in the EPR spectra of the radicals with temperature is connected with the existence in the radicals of hindered rotation (or oscillation) along the C–C bond. The dependencies of the frequency of these conforming transitions P on the temperatures of the samples were obtained for alkyl radicals, stabilized in adducts of urea esters, and for the radicals $R-CH_2-C=NH$ in adducts of nitril with urea. All dependencies were described by the Arrhenius law. The parameters of these dependencies (activation energy and pre-exponent) depend on the dimensions of the radicals and the nature of the particles stabilized in the urea channels by a series with end fragments of alkyl radicals. (tr-auth)

26658 RADICALS IN γ-IRRADIATED ADAMANTANE WITH ADMIXTURE OF CYCLOPENTANE AND TETRAHYDROFURAN. Kuleshov, A. P.; Trofimov, V. I. (Inst. of Chemical Physics, Moscow). Zh. Strukt. Khim.; 14: No. 5, 926-927(1973). (In Russian).

The EPR spectra of pure adamantane and adamantane with admixtures of cyclopentane and tetrahydrofuran, γ-irradiated at −196°, were measured. With increasing temperature the appearance of new lines in the spectra is observed. These are secondary radicals originating from the primary adamantane radicals. The dependence of the frequency of exchange on temperature was established. (JSR)

26659 GAS CHROMATOGRAPHIC ANALYSIS OF THE PRODUCTS FROM GAMMA-INDUCED REACTION BETWEEN H_2 AND CCl_4. Hild, S. L. E.; Molinari, M. A.; Videla, G. J. (Comision Nacional de Energia Atomic, Buenos Aires). Chromatographia; 6: No. 10, 440-442(Oct 1973).

To obtain an adequate separation of the products of this reaction which consisted of a mixture of chloro derivatives in solution in CCl_4, with concentrations less than 0.1%, the method of programmed temperature (100–160°C) gas chromatography was applied. A column containing 30% DC-11 silicone on chromosorb W, and ionization detectors were used. Five products (CH_2Cl_2, $CHCl_3$, C_2Cl_4, C_2HCl_5 and C_2Cl_6) were identified. Quantitative determination of two of them ($CHCl_3$ and C_2Cl_6) was made, using calibration curves. (GE)

26660 PROCESS FOR PREPARING CROSSLINKED COPOLYMERS OF TETRAFLUOROETHYLENE AND PROPYLENE. Tabata, Y.; Kozima, Y. (to Japan Atomic Energy Research Inst.). Japanese Patent 1973-25747. 11 Dec 1969. 2p.

Cross-linked copolymers of tetrafluoroethylene and propylene are made by a process which comprises producing tetrafluoroethylene-propylene copolymers by means of irradiation of the system consisting of tetrafluoroethylene and propylene with ionizing radiations until at least 10% of the produced copolymers are converted into cross-linked copolymers, and then separating uncross-linked copolymers from the cross-linked copolymers. This process permits cross-linked elastomers to be produced with one unit reactor of one step operation. The molecular ratio of tetrafluoroethylene to propylene ranges between 99 to 1 and 1 to 99. The ionizing radiation may be gamma rays, alpha particles, electron beams, and the like in the range between 100 and 1,000,000 rad/hr, preferably with the dose of 10^6 rad or more. The solvent to be employed may be, for example, t-butylalcohol in which monomer but not copolymer dissolves. Copolymerization reaction temperature ranges from 40 to 100°C. In examples, 18.6 g of tetrafluoroethylene and 3.9 g of propylene are fed to a Pyrex glass ampoule; air is removed by repeated solidification, deaeration and fusion; and the content irradiated at −23°C with gamma-rays from ^{60}Co source at a dose rate of 3.0×10^5 rad/hr for 35 hr. Thus, 124 g of copolymer is obtained. This product is treated with tetrahydrofuran to produce 7.4 g of cross-linked elastomer. (JA)

26661 GAMMA IRRADIATION OF URIDYLIC ACID. Cleavage of the N-Glycosidic Linkage. Ducolomb, R.; Cadet, J.; Teoule, R. (CEN, Grenoble, France). Int. J. Radiat. Biol.; 25: No. 2, 139-149(Feb 1974). (In French).

The action of gamma rays on an aqueous solution of uridylic acid was studied at pH ~ 6 (10^{-4} M). Thin-layer silica gel chromatography and spectroscopic methods (such as mass spectrometry, NMR, IR) enabled the identification of eight substances; G values were calculated for the dose of 16 krads. There were trans (G = 0.05) and cis 5,6-dihydroxy-5,6-dihydro-uracil (G = 0.03), isodialuric acid (G = 0.01), 5-hydroxy-hydantoin (G = 0.01), alloxan (traces), parabanic acid (traces), N-formyl-N′-glyoxyl urea (maybe in cyclic form N-1 formyl 5-hydroxy hydantoin) (traces) and uracil (G = 0.28). It appeared that the cleavage of the N-glycosidic linkage was an important reaction. The presence of indirectly detected ribonolactone phosphate was explained by the rupture of the C–N bond after the attack to carbon 1′. The heterocyclic pyrimidic moiety was the most sensitive part of the molecule to the action of the OH radicals. However the degradation of the ribosidic fragment accounted for the remaining 40% of the total effect. (auth)

26662 SOME FEATURES OF THE FORMATION AND YIELD OF FLUORINE-18 FROM FLUOROPLASTIC EXPOSED TO NEUTRONS AND γ QUANTA. Kucher, A. M.; Penionzhkevich, Yu. E.; Flerov, N. G. High Energy Chem. (USSR) (Engl. Transl.); 7: No. 4, 316-319(1973).

Translated from Khim. Vys. Energ.; 7: No. 4, 362-367(1973).

The formation and yield of fluorine and its compounds from fluoroplastic has been studied as a function of different parameters (temperature of the surrounding medium, thickness of the fluoroplastic samples, etc.), during exposure to neutrons and γ

quanta (10^{10} particles/cm^2·sec). Free fluorine was determined by activation-analysis methods using the radioactive isotope fluorine-18. The results obtained permit extrapolations for the determination of the yields of various fluorine-containing products from fluoroplastic, and also the drawing of certain conclusions regarding the mechanism of reactions proceeding is polymers exposed to nuclear radiation. (auth)

26663 INVESTIGATION OF PARAMAGNETIC CENTERS IN IRRADIATED ACRYLAMIDE. Akhvlediani, I. G.; Nekhoroshev, V. G.; Muromtsev, V. I.; Sheinker, A. P.; Abkin, A. D. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 4, 322-324(1973).

Translated from Khim. Vys. Energ.; 7: No. 4, 370-372(1973).

Results from the investigation of paramagnetic centers in polycrystalline acrylamide irradiated with ^{60}Co γ-rays at −196°C are given. The results give a basis for proposing that at least three types of paramagnetic centers are formed. (LK)

26664 EFFECT OF TEMPERATURE AND DOSE RATE ON THE OXIDATION OF ISOSAFROLE. Komarov, P. N.; Baranova, N. M. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 4, 325-327(1973).

Translated from Khim. Vys. Energ.; 7: No. 4, 372-374(1973).

The effects of temperature, dose-rate, and some additives on the γ-radiation-initiated oxidation of isosafrole in the absence of a solvent and in acetic acid solution were studied. Isosafrole concentrations of 1.6 and 2.3 μ were used. (LK)

26665 EFFECT OF AN ELECTRIC FIELD ON ABSORPTION SPECTRA DURING PULSE RADIOLYSIS OF N-HEPTANE AND ISOOCTANE IN THE PRESENCE OF MOLECULAR OXYGEN. Zimina, G. M.; Bakh, N. A.; Vannikov, A. V. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 4, 334-335(1973).

Translated from Khim. Vys. Energ.; 7: No. 4, 378-380(1973).

Studies of the pulse radiolysis of normal and branched alkanes saturated with oxygen showed that the resulting short-lived absorption spectra represent the superposition of individual Gaussian bands having maxima λ_{max} at 270 nm (I), 252 nm (II) and 286 nm (III); with increased sensitivity of measurement band IV, was detected with λ_{max} 312 nm. It was also shown that olefins give bands with λ_{max} 270, 288 and 312 nm, but in the absence of alkanes there is no band with λ_{max} ~ 252 nm. It was demonstrated that only band I belongs to a peroxide radical; the remaining bands, which are absent, like the first, in evacuated samples, are apparently due to oxygen-containing short-lived particles having a different structure. The decay of band I occurs in a second-order reaction, III and IV in first-order processes. (LK)

26666 EFFECT OF IRRADIATION TEMPERATURE ON THE CHARACTER OF RADIATION CROSS-LINKING OF CIS-POLYBUTADIENE. Sobolev, V. S.; Zaides, A. L.; Klauzen, N. A. (Scientific-Research Inst. of the Tire Industry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 4, 312-315(1973).

Translated from Khim. Vys. Energ.; 7: No. 4, 358-361(1973).

Increasing the temperature of γ-ray irradiation of stereoregular polybutadiene in the interval 20−160°C is accompanied by a significant increase in the rate of cross-linking and, at the same time, by a deterioration in the stability of the pure vulcanized rubber and a decrease in the maximally attained degree of crystallinity and intensity of crystal formation upon stretching. It is proposed that the indicated changes are associated with the occurrence of polymerization processes, leading to the formation of polyfunctional blocks. (auth)

26667 INFLUENCE OF TEMPERATURE ON THE RADIOLYSIS OF AQUEOUS SOLUTIONS OF ETHYLENE GLYCOL. Vetrov, V. S.; Kalyazin, E. P.; Petryaev, E. P.; Sokolov, V. N. (Inst. of Nuclear Energetics, Minsk). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 4, 336-337(1973).

Translated from Khim. Vys. Energ.; 7: No. 4, 380-381(1973).

Aqueous solutions of ethylene glycol were subjected to gamma radiation over a temperature interval of 20−170°C. Increasing the temperature led to a substantial change in the radiation chemical yield of the basic radiolysis products. (LK)

26668 INFLUENCE OF TEMPERATURE ON THE PROPERTIES OF SOLVATED ELECTRONS IN IRRADIATED HEXAMETHYLPHOSPHORUS TRIAMIDE. Mal'tsev, E. I.; Vannikov, A. V. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 4, 338-339(1973).

Translated from Khim. Vys. Energ.; 7: No. 4, 382-383(1973).

The temperature dependence of the optical absorption spectra of e^-_{solv} in hexamethylphosphorus triamide and the dependence of the mobility of e^-_{solv} on the temperature are reported. (LK)

26669 EFFECT OF POLYESTER PLASTICIZERS ON THE RADIATION CROSSLINKING OF COMPOSITIONS OF POLY(VINYL CHLORIDE) AND TRIALLYL ESTERS OF CYANURIC ACID. Dakin, V. I.; Egorova, Z. S.; Barshtein, R. S.; Ryzhakova, L. V.; Karpov, V. L. Plast. Massy; No. 5, 18-20(1973). (In Russian).

The results of the investigation of the effect of some polyester plastizers on the radiation cross-linking of polyvinyl chloride and compositions of polyvinyl chloride and cyanuric acid triallyl esters were reported. It was established that during the irradiation of polyvinyl chloride in the presence of the polyester plasticizers studied an unbroken three-dimensional structure is not formed. The change of the diffusion coefficient with the change of the irradiation dose depends on the type of polyester plasticizer. The radiation cross-linking of polyvinyl chloride and cyanuric acid triallyl esters is significantly intensified in the presence of polyester plasticizers. The greatest density of radiation cross-linking of the mixture is observed in the presence of ethylene glycol-based polyester plasticizers. The possible causes of the synergism of the component effects during radiation cross-linking are examined. (tr-auth)

26670 ABSORPTION SPECTRA OF SOLVATED ELECTRONS IN ISOPENTANOL AND IN ISOPENTANOL−n-HEPTANE MIXTURES. Rudnev, A. V.; Vannikov, A. V. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 4, 299-303(1973).

Translated from Khim. Vys. Energ.; 7: No. 4, 342-347(1973).

In the pulsed irradiation of vacuum-treated isopentanol in the region of 500−1000 nm, a short-lived optical absorption signal was recorded, ascribed to the solvated electron. The optical absorption spectrum of e^-_s has several maxima: 510, 550, 590, 620, 675, 715, and 890 nm. When the temperature is lowered, there is a shift of the absorption bands into the short-wave region. The coefficient of the temperature shift $-dE/dT = (8.8-0.2)\cdot10^{-3}$ eV/deg. The radiation chemical yield of e^-_s, is determined according to the yield of the anthracenide anion, $G(e^-_s) = 0.35$ particles/100 eV. The formation of e^-_s in the system isopentanol−heptane was recorded. The temperature dependence of $G(e^-_s)$ in the mixture was obtained. An increase in the force of the oscillator of e^-_s from the pure alcohol to an alcohol−hydrocarbon mixture is noted. The results are considered from the standpoint of localization of electrons in cavities of various structures. (auth)

26671 RADIOCHEMICAL OXIDATION OF Fe^{2+} IONS IN NITRIC ACID SOLUTIONS. Kulikov, I. A.; Vladimirova, M. V. High Energy Chem. (USSR) (Engl. Transl.); 7: No. 4, 304-308 (1973).

Translated from Khim. Vys. Energ.; 7: No. 4, 348-353(1973).

The radiochemical oxidation of Fe^{2+} was studied in sulfuric acid solutions containing NO_3^- ions, and in nitric acid solutions ($[NO_3^-] = 10^{-3}-0.5$ M), under the effect of gamma rays from ^{60}Co. The yields of Fe^{3+} ions and HNO_3 molecules in aerated and deaerated solutions were determined. Fe^{2+} is oxidized in reactions with OH, HO_2, and NO_2 radicals and H_2^+ ions and H_2O_2. An increase in the NO_3^- ion concentration in the solutions from 10^{-3} to 0.1 M increases the Fe^{2+} oxidation yield. A mechanism is proposed for the radiolysis of solutions containing Fe^{2+}. (auth)

26672 RADIATION POLYMERIZATION OF BUTANEDIOL DIMETHACRYLATE IN THE LIQUID PHASE. Gusakovskaya, I. G. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 4, 309-311(1973).

Translated from Khim. Vys. Energ.; 7: No. 4, 354-357(1973).

Certain aspects of the radiation polymerization of butanediol dimethacrylate (BD) in the liquid phase are examined. It is shown that polymerization of BD exhibits the same characteristics whether induced by radiation, photolytic, or chemical mechanisms. At reduced temperatures in the liquid phase anomalies are observed during the polymerization of the monomer; these are explained on the assumption of molecular association. (auth)

26673 THIN-LAYER AND GEL CHROMATOGRAPHY OF SOME ALIPHATIC POLYCARBOXYLIC ACIDS. Kucera, J. (Inst. for Nuclear Research, Rez, Czech.); Pokorny, S.; Coupek, J. J. Chromatogr.; 88: No. 2, 281-287(30 Jan 1974).

Mixtures of telomers obtained by the radiation-induced addition of 2-octanol to maleic acid and containing 2-10 carboxylic groups per molecule were analyzed by thin-layer chromatography on silica gel impregnated with potassium hydrogen sulphate in n-hexane-acetone as solvent and by gel chromatography in tetrahydrofuran on styrene-divinylbenzene copolymers. R_m values, relative zone velocities and molecular weights of the individual telomers were calculated. By a combination of thin-layer and gel chromatography, polycarboxylic acids were successfully fractionated and identified. (auth)

26674 RADIATION INDUCED POLYMERIZATION OF VINYL BENZOATE. II. Study the Molecular Weights of Polymers. Kumar, V.; Rao, K. N.; Shankar, J. (Bhabha Atomic Research Centre, Bombay). Radiat. Eff.; 20: No. 1-2, 69-74(1973).

In this study, the molecular weight of the polymer from vinyl benzoate has been reported for different dose rates and different temperatures. The mol. wt. remains around 4000. With increasing dose, the molecular weight increases to about 14,000. The degrees of polymerization (D^-Pn) and the kinetic chain lengths calculated from the experimentally determined G_R values have been compared which show that the kinetic chain length is larger than the D^-Pn. From a plot of the $(D^-Pn)^{-1}$ vs. R_p (rate of polymerization), an intercept is obtained which is equal to 3.25×10^{-2} which is higher than obtained in conventional polymerization. By examining the effect of temperature on molecular weight, the dependence of R_p on dose rate and the absence of induction period it has been concluded that chain transfer occurs to impurities that are generated during radiolysis. (auth)

26675 RADIATION-INDUCED SYNTHESIS OF ORGANO-PHOSPHORUS COMPOUNDS FROM INDENE AND PHOSPHORUS TRICHLORIDE. Babkina, E. I.; Vinogradskaya, L. S.; Dobrova, E. I.; Gur'eva, N. A. J. Gen. Chem. USSR (Engl. Transl.); 43: No. 9, 2069-2070(Sep 1973).

Translated from Zh. Obshch. Khim.; 43: No. 9, 2084-2085 (Sep 1973).

In the γ irradiation of mixtures of indene and PCl_3 under conditions optimum for chain addition of PCl_3 and for polymerization of indene, only one telomer was produced. In the γ irradiation of mixtures at 150 to 180 rad/sec chain addition of PCl_3 is still not observed, but both telomers and monomers are formed. (JSR)

26676 DIRECT EFFECT IN THE GAMMA RADIOLYSIS OF FROZEN AQUEOUS SOLUTION OF NITRATES. Kalecinski, J. (Inst. for Low Temperature and Structure Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 22: No. 1, 21-30(1974).

The γ radiolysis of aqueous solutions of Li, Na, K, Mg, Sr, and Ag nitrates frozen at 77 and 195°K was examined. The yields of the direct effect $G(NO_3^-)$ were shown to depend on the type of the nitrate and to correlate with the free volumes (V_f) of the solutions. (auth)

26677 EPR STUDIES ON THE GAMMA-IRRADIATED URANYL COMPOUNDS IN ALCOHOL SOLUTIONS. Jezowska-Trzebiatowska, B.; Dziegielewski, J.; Kozlowski, H. (Joliot-Curie Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 22: No. 1, 43-46(1974).

$UO_2(NO_3)_2 \cdot 6H_2O$ and $UO_2Cl_2 \cdot H_2O$ solutions in n-amyl alcohol, irradiated with γ rays were examined by the EPR method. The presence of hyperoxide radicals was detected and the effect of the uranyl salt concentration and of radiation dose on its yields determined. The formation process of radicals in the coordination sphere of U(VI) was proposed. (auth)

26678 RADIATION-INDUCED PAIR-WISE RADICAL FORMATION IN SINGLE CRYSTALS OF THYMINE. Dulcic, A.; Herak, J. N. (Univ. of Zagreb). Biochim. Biophys. Acta; 319: No. 2, 109-115(24 Aug 1973).

Upon irradiation of the single crystals of thymine at 77°K, radicals are formed in pairs with interradical distance of a few Ångstrom units. Each pair consists of two identical radicals, each formed by a loss of a hydrogen atom from the methyl group. It is suggested that one of the radicals in the pair is formed by localization of the energy deposited in excitations. The released low energy methyl hydrogen atom subtracts another hydrogen atom from the methyl group of a neighboring molecule. (INIS)

26679 RADIATION-INITIATED EMULSION POLYMERIZATION OF VINYL CHLORIDE IN THE PRESENCE OF CATION EMULSIFIERS. Smirnov, A. M.; Lukhovitskii, V. I.; Pozdeeva, R. M.; Karpov, V. L. (Scientific-Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. B; 15: No. 12, 907-909(Dec 1973). (In Russian).

The following cation emulsifiers were used at concentrations of 0.01, 0.1 and 1.0 wt %: cetyl pyridine chloride (CPC) and bromide (CPB), cetyl trimethylammonium bromide (CTB) and alkamon OS-2 (a mixture of benzene sulfonate methyldiethylaminomethyl derivatives of diethyleneglycol ethers of higher fatty alcohols). Dose was imparted at a rate of 70 rads/sec. The polymerization rate in the presence of CPC, CPB, and CTB increases with increasing concentration of emulsifier up to 0.005 wt %. The polymerization rate is constant in the concentration range of surface active substance from 0.005 to 0.01 wt %. At emulsifier concentrations above 0.01% the polymerization rate decreases sharply and attains a minimum value at concentrations of 0.2 to 0.5 wt % which are close to values of the critical concentration for micelle formation (CCM). The polymerization rate at emulsifier concentrations above CCM depends on the amount of surface-active material to a power of 0.6. The polymerization rate at emulsifier concentrations below CCM (0.005 to 0.01 wt %) significantly exceed the polymerization rate which is obtained in the presence of surface-active substances taken at concentrations above CCM (5 wt %). The fact that the polymerization rate is minimal at emulsifier rates close to the value of the critical concentration for micelle formation and stabilization of latex particles. It should be noted that the polymerization rate at emulsifier concentrations of 0.005 to 0.01 wt % is close to the rates obtained in the presence of anion emulsifiers under the same conditions. For the alkamon OS-2 emulsifier the fall in polymerization rate is observed at concentrations significantly exceeding CCM (CCM = 0.25 wt %). (SJR)

26680 RADIOLYSIS OF ADAMANTANE. Hyfantis, G. J. Jr.; Ling, A. C. (Univ. of West Virginia, Morgantown). Chem. Phys. Lett.; 24: No. 3, 335-339(1 Feb 1974).

Bromine scavenging experiments, and comparative radiolysis of adamantane and adamantane derivatives, indicate that adamantane forms the 1-adamantyl radical as the predominant species following γ-radiolysis. (auth)

26681 PRODUCTION OF SOLVATED ELECTRONS, ION-PAIRS, AND ALKALI METAL ANIONS IN TETRAHYDROFURAN STUDIES BY PULSE RADIOLYSIS. Salmon, G. A.; Seddon, W. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Chem. Phys. Lett.; 24: No. 3, 366-368(1 Feb 1974).

Pulse radiolysis of tetrahydrofuran (THF) and solutions of $NaAlH_4$ in THF shows the formation of solvated electrons (e_s^-), their conversion to ($Na^+ - e_s^-$) ion-pairs and ultimately the alkali metal anion (Na^-). (auth)

26682 YIELDS OF RADIATION PRODUCTS IN SODIUM METAPHOSPHATE GLASSES. Kobayashi, Y.; Barkatt, A.; Rabani, J. (Hebrew Univ., Jerusalem). J. Phys. Chem.; 78: No. 7, 752-756(28 Mar 1974).

Metaphosphate glasses have been irradiated and dissolved in aqueous solutions, where the trapped positive and negative species, MP^+ and MP^-, respectively, reacted with scavengers. I^-, O_2, $Fe(CN)_6^{4-}$, Fe^{3+}, and TMPD have been used to scavenge MP^+ and MP^-. From product analysis, $G(MP^+) = G(MP^-) = 2.2 \pm 0.1$ was calculated. Combining this with absorbance measurements in glasses yields $\epsilon^{500}(MP^+)$ (the extinction coefficient of MP^+ at 500 nm) = $(1.92 \pm 0.17) \times 10^3$ M^{-1} cm^{-1}. MP^- reacts with aqueous O_2 to produce peroxy radicals (O_2^- or MPO_2^-). Whatever peroxy radicals are formed, they decay in water to produce H_2O_2. MP^- does not react with N_2O and does not produce H_2 upon reaction with alcohols in acid solutions. It is concluded that MP^- does not form e_{aq}^- or H upon its interaction with water. Pulse radiolysis experiments show that aqueous solutions of metaphosphate are relatively inert toward e_{aq}^- and OH. $k(e_{aq}^- + MP) < 1 \times 10^6$ and $k(OH + MP) < 5 \times 10^6$ M^{-1} sec^{-1}. (auth)

26683 γ-RADIOLYSIS OF TRYPSIN, AND CHYMOTRYPSINOGEN WHEN ASSOCIATED WITH DNA. Lynn, K. R. (National Research Council of Canada, Ottawa). Radiat. Res.; 57: No. 3, 395-402(Mar 1974).

Complexes between DNA and chymotrypsin, chymotrypsinogen, and trypsin were irradiated as aqueous solutions. Marked protection was afforded the enzymes in the associations, and this was not attributable to radical scavenging by the nucleic acid component. Enzymatic activity was lost in a manner unique to each preparation of complex and to each of several substrates employed, which suggests that the precise interaction between the nucleic acid and protein components is critical in affecting the nature of the damage sustained by the protein. This was confirmed by amino acid analysis. The character of the destruction of amino acid residues after radiolysis of the complexes suggests that random attack by the products from the irradiation of water occurs on the proteins. The active sites are apparently protected either by the geometry of the DNA/protein complex or by the nucleic acid acting to divert the free radical attack. (auth)

26684 PRODUCT YIELD VS CHAIN LENGTH IN γ-RADIOLYSIS OF NORMAL SATURATED FATTY ACIDS. Wu, G. S.; Howton, D. R. (Univ. of California, Los Angeles). Radiat. Res.; 57: No. 3, 390-394(Mar 1974).

G-yields of hydrocarbons resulting from ^{60}Co γ-irradiation of normal saturated C_{12}, C_{14}, C_{16}, C_{18}, C_{20}, and C_{30} fatty (carboxylic) acids in the crystalline state (and of the C_{16} and C_{18}

acids in the liquid state) have been determined. G_{RH} values obtained are in substantial agreement with G_{CO_2} values recently reported for the same substances (excepting the C_{30} homolog) by Jones and his observation that G_{CO_2} (and hence G_{RH}) is, in general, inversely related to chain length is confirmed. Contrary to earlier claim melissic acid (triacontanoic acid, the C_{30} homolog) behaves normally in this regard. Departures from the inverse chain-length relationship are compatible with and may be rationalized by consideration of an additional inverse effect of the density of the irradiated material. (auth)

26685 PULSE RADIOLYSIS STUDY OF INTERACTIONS IN BIOLOGICAL MOLECULES. Phillips, G. O.; Power, D. M.; Richards, J. T. (Univ. of Salford, Eng.). Israel J. Chem.; 11: No. 4, 517-527(1973).

Using pulse radiolysis techniques, the binding of penicillin and cephalosporin drugs to proteins (bovine serum albumin and lysozyme) was studied using rate constants obtained for reactions with solvated electrons as a monitor of the binding. The results obtained are discussed in terms of three distinct types of binding. (auth)

26686 PROCESS FOR PREPARING COPOLYMERS OF TETRAFLUOROETHYLENE. Ukihashi, H.; Yamabe, M.; Suwa, M. (to Asahi Glass Co. Ltd., Tokyo). Japanese Patent 1973-25415. 23 Jun 1969. 5p.

Tetrafluoroethylene copolymers are prepared by a process which comprises copolymerizing tetrafluoroethylene, ethylene and fluoroolefines excluding tetrafluoroethylene in the presence of polymerization initiators so that the fluorine content may be 49% or more by weight in the product. The process improves the molding characteristics without affecting the heat resistance. When hexafluoropropylene, vinylidene fluoride, vinyl fluoride, and the like in the proportion of molecular ratio 30 to 70 C_2F_4/70 to 30 C_2H_4 and 1 C_2F_4/0.1 to 1 fluoroolefines are copolymerized, the product copolymers have the excellent molding characteristics as well as good heat resistance. The polymerization initiators may be peroxy-compounds, azo-compounds, ultraviolet radiations or ionizing radiations, preferably high energy ionizing radiations, usually gamma-rays from ^{60}Co source delivering a dose 10^3 to 10^7 rad at a dose rate of 10^2 to 10^9 rad/hr. In one of the examples, 0.96 moles of tetrafluoroethylene, 1.35 moles of ethylene, 0.23 moles of hexafluoropropylene and 2.48 moles of trichloromonofluoromethane, wherein the molecular ratio of hexafluoropropylene/tetrafluoroethylene is 0.25 and monomer/solvent is 1.0, are charged into a 500 ml reactor and copolymerized at -30°C by irradiation with gamma-rays from the ^{60}Co source at a dose rate of 6×10^4 rad/hr for 8.5 hours. The degree of copolymerization is 78%. The product has melting point at 248°C, pour point at 233°C, decomposition point at 305°C, space velocity 3.5 mm³/sec, and excellent molding characteristics in extrusion and injection molding. (auth)

26687 RADIATION-CHEMICAL REACTION OF METHANE AND CARBON DIOXIDE IN THE ELECTRIC FIELD WITH SPECIAL REGARD TO THE FORMATION OF FORMALDEHYDE. Troitzsch, J. Aachen; Technische Hochschule (1972). 108p. (In German).

Thesis.

The radiochemical reaction of methane and carbon dioxide in an electrical field was investigated with special regard to the yield of formaldehyde. The dependence of the yield and of the energy released (in g/kWh) on the homogeneous or inhomogeneous electrical field, the gas mixture ratio, the time of irradiation and on the dose capacity at different voltages was determined. The influence of time on the yield of formaldehyde was investigated in an open and closed circulating system (1, 2, 4, 8, 16 hours). The yields increase proportionally with the experimental time in the open as well as in the closed system, i.e., the yield is solely dependent on the energy taken up by the system per unit of time. The influence of the dose capacity on the formaldehyde yield was investigated at several voltages (6, 7, 8, 9 and 10 kV) in both open and closed systems. With a 12-fold increase of dose capacity at low voltages, the formaldehyde yield could be considerably increased (9-fold) in the open system, whereas at high voltages it only increased 1.5-fold. In the closed system, there is only a 6-fold increase at low voltages and a 1.5-fold one at high voltages. The best yield of formaldehyde and the best energy yield is obtained when working in an inhomogeneous electrical field under given conditions. (GE)

26688 LYOLUMINESCENCE OF IRRADIATED SACCHARIDES. Atari, N. A.; Ettinger, K. V. (Univ. of Birmingham, Eng.). Radiat. Eff.; 20: No. 1-2, 135-139(1973).

Some irradiated saccharides emit light when dissolved in water. Glucose, xylose, and mannose were selected as the most suitable materials for lyoluminescence dosimetry. Using ^{60}Co as a radiation γ-source, the performance of these materials was evaluated from the point of view of sensitivity, stability against thermal annealing or exposure to light, and their linear behavior with doses up to 100 krads. Their lower limit, depending upon the apparatus used, is about 100 rads. With trehalose $\cdot 2H_2O$ and luminol solution, doses between 1 and 10^6 were measured. It appears that trapped free radicals are responsible for the light emission. An attempt was made to correlate their ESR spectra with their lyoluminescent behavior. But the actual mechanism of light emission needs further investigation. (auth)

26689 ELECTRON SPIN RESONANCE OF FREE RADICALS AND RADICAL PAIRS IN IRRADIATED SINGLE CRYSTAL OF 1-METHYLURACIL. Flossmann, W.; Huettermann, J.; Mueller, A.; Westhof, E. (Regensburg Univ., Ger.). Z. Naturforsch., 28c: No. 9/10, 523-532(Sep 1973).

Radical formation by irradiation with x rays in single crystals of 1-methyluracil was measured using ESR spectroscopy at 9.5 GHz and 35 GHz. When irradiating and measuring at 77°K, radicals characterized by hydrogen abstraction from the methyl group were found to predominate. For the hyperfine splittings values of 8.5, 18.2, and 30.5 G were found for both α-protons and 3.3, 2.4, and 1.7 G for the (N1)-splitting. Pairs of abstraction radicals were also found under these conditions, showing quintet splittings of about 10 G and anisotropic dipolar coupling. Average distances parallel to c of 6.3 and 6.5 A were found for two types of pairs, while those perpendicular to c were not analyzed in detail. On irradiating and measuring at room temperature, an additional sextet pattern was found in the spectrum and attributed to a radical formed by addition of hydrogen at C(5). For the hyperfine splittings values of 8.1, 17.5, and 30.0 G were found for the α-proton and 31.2, 34.4, and 34.1 G for the two equivalent β-protons. Radical concentrations were determined at 77°K yielding about 90% abstraction radical, 15% of these in pairs and 10% of additional radical. About half of the abstraction radicals are converted to additional radicals between 200 and 280°K. The latter disappear at about 460°K, leaving a fraction of abstraction radicals which is annealed at even higher temperatures. (GE)

26690 THEORY AND EXPERIMENT IN EXOBIOLOGY. Volume 1. Schwartz, A. W. (ed.). Portland, OR; International Scholarly Book Services, Inc. (1971). 164p. $11.20.

The articles in this volume deal with some chemical and physical problems related to the formation of compounds necessary to living systems, and the techniques involved in the detection of extraterrestrial organic compounds. A separate abstract was prepared for one article. (WDM)

For an abstract of an individual section see: 26691.

26691 ROLE OF IONIZING RADIATION IN PRIMORDIAL ORGANIC SYNTHESIS. Ponnamperuma, C. (Ames Research Center, Moffet Field, CA); Sweeney, M. pp 1-40 of Theory and Experiment in Exobiology. Vol. 1. Schwartz, A. W. (ed.). Portland, OR; International Scholarly Book Services, Inc. (1971).

The problem of revealing how ionizing radiation may have been effective in producing the molecules necessary for life is considered. In examining the sequence of events leading to the appearance of the first organisms, the problem is considered in two parts: the formation of the small molecules such as amino acids, purines, pyrimidines, and carbohydrates; and the condensation of these molecules to give rise to polypeptides and polynucleotides. (WDM)

26692 GAS-PHASE AROMATIC SUBSTITUTIONS: REACTION OF RADIOLYTICALLY FORMED D_2T^+ IONS WITH CHLOROBENZENE AND FLUOROBENZENE. Cacace, F.; Cipollini, R. (Univ., Rome). Radiochem. Radioanal. Lett.; 16: No. 6, 343-354(23 Mar 1974).

The attack of radiolytically formed D_2T^+ ions on chlorobenzene and fluorobenzene was investigated in gas phase, irradiating with the ^{60}Co γ-rays a gaseous system containing D_2 at atmospheric pressure and a low concentration of the aromatic substrate, in the presence of a radical scavenger. The results indicate that the attack of D_2T^+ on C_6H_5Cl leads almost exclusively to tritiodeprotonation (substitution of H by T) the major product being represented by C_6H_4TCl with only traces of C_6H_5T. On the other hand, in the case of C_6H_5F the tritiodeprotonation is accompanied by the extensive tritiodehalogenation (substitution of F by T) as indicated by the high yield of C_6H_5T formed together with C_6H_4TF. The mechanism of the gas-phase electrophilic attack is discussed, and compared to those of other aromatic substitutions by gaseous Brønsted acids. (auth)

26693 RECENT DEVELOPMENTS IN THE RADIATION CHEMISTRY OF PYRIMIDINE BASES IN AQUEOUS SOLUTIONS.

Infante, G. A.; Fendler, E. J.; Fendler, J. H. (Texas A and M Univ., College Station). Radiat. Res. Rev.; 4: No. 4, 301-339 (Dec 1973).

A review is given of the recent developments in three areas of pyrimidine radiation chemistry: structural studies of the initially formed transients, mechanisms of product formation, and effects of micelle-forming surfactants. Data compilations on the available rate constants and G values are provided. The discussion is limited to investigations of uracil, substituted uracils (e.g.; 5-halouracils, orotic acid, and thymine) and cytosine in dilute aqueous solutions. (JSR)

26694 EFFECT OF NEUTRON IRRADIATION ON THE ACTIVITY OF HYDROGENATION CATALYSTS. Nadykto, B. T.; D'yakova, G. A. Tr. Inst. Org. Katal. Elektrokhim., Akad. Nauk Kaz. SSR; 5: 181-188(1973). (In Russian).

The effect of a preliminary radiation processing on the low-percentage Pt group catalysts deposited on γ-Al_2O_3 is studied. By use of the example of the hydrogenation of dimethylethylvinylcarbinol it is shown that irradiation with reactor radiation significantly increases the activity of these catalysts. (tr-auth)

Radiochemistry and Nuclear Chemistry

26695 (CONF-7209111-(Absts.)) NUCLEAR MEDICINE AND RADIOCHEMISTRY. Meeting of the German Chemical Society, Freiburg, 27-29 September 1972. (Gesellschaft Deutscher Chemiker, Frankfurt am Main (F. R. Germany)). [nd]. 12p. (In German and English).

Hot-Atom Chemistry

26696 COMPARISON OF THE REACTIVITY OF RADIOLYTIC AND HOT (RECOIL) HYDROGEN ATOMS IN ADDITION AND ABSTRACTION REACTIONS IN THE CYCLOHEXANE-CYCLOHEXENE SYSTEM IN THE LIQUID PHASE. Kukin, P. O.; Filatov, E. S. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 7: No. 4, 280-283(1973).

Translated from Khim. Vys. Energ.; 7: No. 4, 316-320(1973).

The reactions of recoil tritium atoms and radiolytic hydrogen atoms (arising in the nuclear reaction $^6Li(n,\alpha)T$ and upon the attendant radiolysis, respectively) in the cyclohexane-cyclohexene system have been investigated. The radiation-chemical and radiochemical yields of H_2 and HT respectively have been determined. The ratio of the rate constants for the abstraction and addition reactions of hydrogen has been calculated in the case of the radiolytic atoms, $k_3/k_5 = 0.06 \pm 0.02$. Treatment of literature data gives $k_3/k_5 = 0.01 \pm 0.004$ and 0.03 ± 0.01. For recoil tritium atoms, $k_3'/k_5' = 0.34$, which is 5-20 times greater than the corresponding ratios for radiolytic hydrogen atoms; this indicates a difference in the energetic spectra of radiolytic and hot recoil atoms. According to estimate, the yield of hot hydrogen atoms in radiolysis of cyclohexane < 15% of the total radiation yield of hydrogen atoms, which agrees with previously published calculations. (auth)

26697 SYNTHESES OF ^{18}F-LABELLED COMPOUNDS BY DIRECT REACTIONS OF ATOMIC ^{18}F. Rowland, F. S.; Cramer, J. A.; Iyer, R. S.; Milstein, R.; Williams, R. L. (Univ. of California, Irvine). pp 383-394 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

^{18}F-atoms formed by nuclear processes are highly reactive chemically, either while still possessing some kinetic energy from nuclear recoil, or after thermalization by non-reactive collisions with inert molecules. Systematic studies are reported of these reactions of atomic ^{18}F with a variety of simple organic and inorganic molecules. In many instances, no information has previously been available about the reactions of atomic fluorine with these molecules because of the highly reactive nature of macroscopic fluorine sources and/or some of the products, together with the high rates and exothermicities for many of these reactions. Most of these difficulties are avoided with ^{18}F at tracer levels. Some molecules are inert towards reaction with ^{18}F: xenon and other rare gases; N_2. Others show slight reactivity towards energetic ^{18}F and are inert to thermalized ^{18}F: SF_6, CF_4, NF_3. These molecules can be used in excess to moderate ^{18}F atoms to thermal energies. Thermalized ^{18}F atoms react with SF_4, OSF_2 and SiF_4 in high yields to form the corresponding ^{18}F-labelled compound: $SF_3{}^{18}F$, $OSF^{18}F$, $SiF_3{}^{18}F$. These compounds can then be used as starting materials for further chemical syntheses. Thermal ^{18}F reacts efficiently with all C-H bonds to abstract H from $H^{18}F$. Addition to multiple bonds can compete with such abstraction reactions, and high yields are found for addition products such as $CH^{18}F = CH$ (83% from $^{18}F + C_2H_2$), $CH_3{}^{18}FCH_3$ (65% from $^{18}F + C_3H_6$), etc. Competitive studies show that ^{18}F atoms are not very selective and will react by addition with all available kinds of multiple bonds intermolecularly and with both ends of each available bond. The addition products for thermalized ^{18}F atoms added to an olefinic carbon atom also bonded to Cl or Br are not observed in the gas phase; instead, the other halogen atom is replaced and a ^{18}F-labelled olefin is formed. Thermalized ^{18}F atoms attack Si-C bonds with the displacement of H bonded to Si, and Sn-C bonds with the displacement of Sn. These reactions proceed in appreciable yield in competition with H abstraction from the CH_2 positions. Addition of thermal ^{18}F to benzene results in the formation of $C_6H_5{}^{18}F$ with a yield of 17% in the absence of O_2. As O_2 is added to the mixture, the yield of $C_6H_5{}^{18}F$ increases steadily with values > 90% for O_2/benzene $\gg 1$. (auth)

26698 PRESSURE AND PHASE DEPENDENCE OF THE STEREOCHEMICAL COURSE IN HOT TRITIUM FOR HYDROGEN AND CHLORINE-38 FOR CHLORINE SUBSTITUTION IN MESO- AND RAC-1,2-DICHLORO-1,2-DIFLUOROETHANE. Machulla, H. J.; Stocklin, G. (Kernforschungsanlage, Juelich, Ger.). J. Phys. Chem.; 78: No. 7, 658-662(28 Mar 1974).

The pressure dependence of the stereochemical course in hot homolytic T-for-H and ^{38}Cl-for-Cl substitution in meso- and rac-1,2-dichloro-1,2-difluoroethane has been studied from 10 to 10^4 Torr. Distinct differences are observed between the yield vs. density dependence of the retained and the inverted product. For both recoil tritium and chlorine, substitution with inversion of configuration is almost negligible in the gas phase and its yields remained constant over the entire pressure range studied. Typical pressure effects are observed, however, for substitution with retention of configuration, particularly for recoil chlorine. While the change from the high-pressure gas phase to the liquid leaves T-for-H substitution almost unaffected, ^{38}Cl-for-Cl substitution exhibits a strong phase effect. The absolute yields of the retained product increase by a factor of 2.5, that of the inverted product by about 20, almost identical in both diastereomeric substrates. The density dependence of the HCl and HF elimination products is also different for recoil tritium and chlorine; in the latter case the yields follow the increasing trend observed for substitution. While for recoil tritium the predominant substitution channel seems to be a direct replacement with retention of configuration, even in the liquid phase, ^{38}Cl-for-Cl substitution at higher densities cannot be satisfactorily explained on the basis of the impact model nor by caged radical combination. Alternatively, substitution via a caged complex is discussed. (auth)

26699 STEREOCHEMICAL STUDIES OF THE RADIOCOBALT EXCHANGE IN SOLIDS CONTAINING THE $Co(pn)_2Cl_2^+$ ION. Aalbers, D. L.; LeMay, H. E. Jr. (Univ. of Nevada, Reno). Inorg. Chem.; Inorg. Chem.; 13: No. 4, 940-944(Apr 1974).

The solid-phase radiocobalt exchange reactions between labeled $CoCl_2$ and the complexes trans-$[Co(pn)_2Cl_2]Cl$, trans-$[Co(pn)_2Cl_2](H_5O_2)Cl_2$, and cis-$[Co(pn)_2Cl_2]Cl \cdot H_2O$ (pn = 1,2-diaminopropane) were studied in static air at 100, 120, and 150°. Although isomerization occurs during dehydration, cobalt exchange takes place mainly after dehydration and occurs with complete retention of configuration. In some cases, however, $Co(pn)_3^{3+}$ forms. The results are compared with those obtained in transfer annealing and postradiation annealing studies of related complexes. (auth)

26700 CHEMICAL EFFECTS OF THE DECAY OF ^{121}I TO ^{121}Te. Hillman, M.; Nagy, A.; Weiss, A. J. (Brookhaven National Lab., Upton, NY). Radiochim. Acta; 19: No. 1, 9-12(1973).

The chemical effects accompanying the predominantly electron capture decay of ^{121}I to ^{121}Te in aqueous solution were found to resemble somewhat the chemical effects of the isomeric decay of ^{127m}Te and of ^{123m}Te. Differences dependent on the different initial oxidation states were observed, but they were not as large as in the tellurium case. An easily oxidizable intermediate was also observed. (GE)

26701 RADIATIVE NEUTRON CAPTURE AND ISOMERIC TRANSITION ISOTOPE EFFECTS IN BROMINE REACTIONS WITH LIQUID CYCLOHEXANE AND CARBON TETRACHLORIDE: A RE-EVALUATION. Grauer, W. M. (Univ. of Nebraska, Lincoln); Rack, E. P.; Lambrecht, R. M. Radiochem. Radioanal. Lett.; 16: No. 6, 289-301(23 Mar 1974).

Several experimental techniques, including changing the phase of the sample after irradiation, use of the freeze-thaw method, immediate extraction, and extraction as a function of time from the liquid or solid state were used to re-evaluate the radiative neutron capture organic yields of ^{80}Br, ^{80m}Br, and $^{82m+82s}$Br and the ^{82}Br isomeric transition organic yields in liquid cyclohexane and in carbon tetrachloride. It was concluded that under the conditions studied there was no observable isotope effect within experimental error between (n,γ)-activated yields of ^{80}Br, ^{80m}Br, or $^{82m+82s}$Br, and (IT)-activated ^{82}Br. The lack of an (n,γ) isotope effect and the similarity of the organic yields by the two activation process suggest a mechanism or mechanisms involving caging reactions. (auth)

26702 HOT ATOM CHEMICAL STUDIES ON ZIRCONIUM ACETYLACETONATE BY SUBLIMATION METHOD. Kawazu, H.; Sakanoue, M. (Kanazawa Univ., Japan). Radiochem. Radioanal. Lett.; 16: No. 6, 373-380(23 Mar 1974).

The acetylacetonate of Zr (Hf) was irradiated with thermal neutrons and the chemical effects were studied by applying the sublimation method. The retention values of ^{95}Zr, ^{97}Zr and ^{181}Hf were found nearly the same and similar to that of ^{231}Th produced by the (n,2n) reaction of thorium acetylacetonate. Furthermore, it was found that the activity of niobium produced in the irradiated Zr acetylacetonate did not sublime. (auth)

Properties of Radioactive Materials

Refer also to abstracts 26630, 26834, 27129, 27149, 27151, 27154, and 27158.

26703 (BARC-716, pp 71-72) THERMODYNAMICS OF UO_2^{++}-PO_4^{---} SYSTEM. Sundaresan, M.; Awasthi, S. P.; Suryanarayanan, C. S. 1973.

26704 (BARC-716, pp 77-78) THERMOGRAVIMETRIC STUDY OF THE DECOMPOSITION OF URANYL OXALATE TRIHYDRATE. Ravindran, P. V.; Radhakrishnan, T. P.; Sundaram, A. K. 1973.

26705 (COO-2361-1) LABELING PHARMACEUTICALS WITH RADIOACTIVE ISOTOPES. Annual Progress Report, June 1, 1973–February 28, 1974. Blau, M.; Bender, M. A. (Roswell Park Memorial Inst., Buffalo, N. Y. (USA)). [nd]. Contract AT(11-1)-2361. 12p. Dep. NTIS $3.00.

Potentially useful radiopharmaceuticals labeled with ^{18}F or ^{131}I may be prepared by either homogeneous or heterogeneous halogen interachange procedures, giving amino acid analog compounds where an I-for-methyl or F-for-H substitution has taken place. These radio-labeled compounds will be evaluated for potential clinical utility via specific organ localization. Progress is reported in developing a suitable ^{18}F source, free of carrier fluorine as well as of chemical and radionuclidic contaminants; preparation of surfaces and matrices for halogen interchange; initial testing of ^{18}F-labeled surfaces with model compounds; identification and removal of tritium-containing organic compounds found in clinical ^{18}F preparations, and preparation of several compounds which, after halogen interchange, can be used to produce I-for-methyl amino acid analogs. (auth)

26706 (FRNC-TH-425) STUDY OF THE BEHAVIOR OF POLYSTYRENE-SULFONATE TYPE ION EXCHANGE MEMBRANES IN THE PRESENCE OF VARIOUS CATIONS. Servage, R. (Grenoble-1 Univ., 38 (France)). 1973. 127p. (In French). Dep. NTIS (U. S. Sales Only) $8.50.

Thesis.

The behavior of a cation membrane consisting of an ion exchange resin and vinyl chloride-alkyl maleate copolymers was studied. The conductivity, swelling, transport number, and quantity of electrolyte absorbed by the membrane in the presence of one or two identically charged or differently charged cations were determined. The migration of UO_2^{++} and Th^{4+} cations in electrodialysis was studied as an application of the research carried out. (FR)

26707 (FRNC-TH-478) STUDY OF OXIDATION REDUCTION PROPERTIES OF CARRIER FREE Np IN ALKALINE SOLUTIONS. Stability of ^{239}Np(VII). Espinosa, E. (Paris-6 Univ., 75 (France)). 1973. 80p. (In French). Dep. NTIS (U. S. Sales Only) $7.00.

Thesis.

The preparation and identification of carrier-free neptunium in the V, VI and VII oxidation states in basic aqueous media were investigated. Two techniques were used: electrophoresis and solvent extraction. Np(V) can exist in basic media either in ionic form or neutral form. The solutions are stable in air. The dibenzoylmethane extraction conditions were established. Np(VI) can be produced in the carrier-free state by oxidizing a ^{239}Np(V) solution with chloride or bromide at room temperature. The ^{239}Np(V)–^{239}Np(VI) separation can be effected by electrophoresis or by solvent extraction. ^{239}Np(VII) can be prepared from ^{239}Np(VI) solutions containing Br, either by heating from 70 to 80°C, or by ozonization at room temperature. Solvent extraction is the best method of determining the degree of oxidation. The utilization of a weighable quantity of Np in the electrophoresis enabled the existence of exchange reactions between Np(V) and Np(VI) and between Np(VI) and Np(VII) to be established. (FR)

26708 (LYCEN-7341) SYNTHESIS, RADIOCHEMICAL LABELING AND PROPERTIES OF SOME ARYL- AND ALKYL-STIBINES AND THEIR HALIDE DERIVATIVES. Benmalek, M.; Chermette, H.; Martelet, C.; Sandino, D.; Tousset, J. (Lyon-1 Univ., 69 – Villeurbanne (France). Inst. de Physique Nucleaire). Jul 1973. 15p. (In French). Dep. NTIS (U. S. Sales Only) $4.00.

The condensation of aryl or alkyl magnesium halides on radiochemically labeled (^{124}Sb) antimony trichloride enables labeled triaryl or trialkyl stibines to be obtained. Triaryl and trialkyl antimony difluorides can be obtained with excellent yields using solvent extraction from the corresponding dichloride, dibromide, or di-iodide, these substances being obtained by condensation of the halogen on stibine. Radiochemical labeling enabled the values of the partition coefficients to be obtained for some of the derivatives, and also the hydrolysis of these compounds to be examined. (FR)

26709 (STI/PUB-344(Vol.1)) RADIOPHARMACEUTICALS AND LABELLED COMPOUNDS. Volume I. Proceedings Series. Proceedings of the Symposium Held in Copenhagen, Denmark, March 26–30, 1973. (International Atomic Energy Agency, Vienna (Austria)). Nov 1973. 510p. (In French and English). (CONF-730309-P1). IAEA $23.00.

Thirty-nine papers were presented at the symposium and separate abstracts were prepared for all papers. (LK)

For abstracts of individual papers see: 26697, 26711–26731, 26757–26766, 27119, 27151–27155, and 27462.

26710 METHOD FOR THE PREPARATION OF TRITIUM LABELED PROTEINS. Lam Thang Hung; Morgat, J. L.; Formageot, P. (to Commissariat a l'Energie Atomique). French Patent 2,154,989. 1 Oct 1971. 8p. (In French).

A method is presented for the preparation of tritium-labeled protein. In this method, an excess of this protein is reacted with another protein having a specific binding action with the first protein, this action leading to the formation of a soluble complex. This complex is halogenated and the resulting halogenated complex is tritiated in such a way as to obtain a mixture formed from the tritiated complex and the halogen complex. The tritiated complex is then dissociated and successive and selective extractions are effected of the tritium-labeled protein and of the tritium-labeled binder. (FR)

26711 NON-PERTECHNETATE RADIOCHEMICAL IMPURITY IN SULPHUR COLLOID LABELLED WITH ^{99m}Tc. Chemical Study of the Labelling Process. Cifka, J.; Vesely, P. (Nuclear Research Inst., Rez, Czech.). pp 53-62 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

Two methods for the preparation of sulfur colloid-^{99m}Tc were studied, (i.e., the thiosulfate method and the hydrogen sulfide method). The labelling process was studied as a function of the concentration of hydrochloric acid or thiosulfate in the solution. It was found that a certain fraction of pertechnetate was reduced up to the Tc(IV) state and was not bound in colloidal particles. The fraction of Tc(IV) increased with increasing time period between the mixing of pertechnetate with thiosulfate and the addition of hydrochloric acid. In several cases more than 10% of the total activity was found in the Tc(IV) fraction. On the other hand, less than 0.5% of the total activity in the Tc(IV) fraction was found for products prepared from hydrogen sulfide. The chromatographic method used for the quality control of labelled sulfur colloid has to separate not only the colloid and pertechnetate but also the colloid and Tc(IV) state. Unfortunately, the Tc(IV) valency state is retained at the starting point of the plates prepared from silica gel or alumina, and cannot be separated from labelled colloidal particles. (auth)

26712 CHEMISTRY OF TECHNETIUM: EFFECT OF OXIDOREDUCTION SYSTEMS ON THE STABILITY OF COMPLEXES USED AS RADIOPHARMACEUTICALS. Merlin, L.; Besnard, M.; Cohen, Y. (CEN de Saclay, Gif-sur-Yvette, France). pp 63-70

of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973). (In Fren...).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

Technetium is produced by the Mo-Tc-generator in its most highly oxidized form - Tc VII. The complexes which it forms with organic acids (ascorbic acid, diethylene-triamino-pentaacetic acid) have a relative stability depending on the pH of the solutions and on the valency which the technetium assumes under the effect of various reducing agents during the preparation of the radiopharmaceutical compound. This stability changes with time because of the presence of atmospheric oxygen in the vessels containing the solutions. After reviewing the present status of information on the chemistry of technetium a description is given of the authors' work on the preparation of low valency technetium compounds under various experimental conditions. (auth)

26713 SYNTHESIS OF TECHNETIUM-99m-LABELLED COMPOUNDS FOR USE AS TRACERS IN GAMMAGRAPHY: GENERAL METHOD OF LABELLING SULPHUR-CONTAINING COMPOUNDS. Vigne, J. P. (Laboratoire de Physique et de Radiobiologie, Marseille). pp 73-77 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

The various methods proposed so far for obtaining technetium-labelled products have certain features in common: in general they use oxidoreduction systems by which technetium can be converted from state VII to state IV and vice versa, and the molecules to be labelled either contain sulfur or else it is introduced in the course of the operations. Investigation of the preparation of Tc-labelled cystine showed that technetium is not bound by cysteine (R-SH) or by cystine (R-S-S-R) but that binding appears to occur at the moment of oxidation. The hypothesis that technetium is bound at the moment of transition from -SH to -S-S- in an oxidizing medium is put forward and demonstrated by labelling bis-dimethyldithiocarbamate through a combination of two dimethyldithiocarbamate molecules in the presence of pertechnetate. Keratin was also labelled, by opening the -SH bridges in the presence of thioglycolic acid and closing them with an oxidant in the presence of pertechnetate, thereby producing a Tc-labelled keratin with quite high specific activity. (auth)

26714 NEW ^{99m}Tc SKELETAL-IMAGING RADIOPHARMACEUTICAL: 1-HYDROXY-ETHYLIDENE-1, 1-DISODIUM PHOSPHONATE ^{99m}Tc COMPLEX (^{99m}Tc- HEDSPA). Castronovo, F. P. Jr.; Callahan, R. J.; Potsaid, M. S.; Pendergrass, H. P.; Neel, H. S. (Harvard Medical School, Boston). pp 79-92 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

The laboratory of Harvard Medical School has been investigating several organophosphorus compounds (carbon-to-phosphorus bond) which have proved to be satisfactory skeletal-imaging agents after labelling with ^{99m}Tc. One such compound is a diphosphonate derivative with the chemical name 1-hydroxy-ethylidene-1, 1-disodium phosphonate, or HEDSPA. Diphosphonates are compounds which contain a carbon-to-diphosphate bond; $R[P(O)(OH)_2]_2$, and the formula for the disodium salt at present being investigated is $CH_3 \cdot C(OH)\{P(O)(OH)(ONa)\}_2$. An outline is given of the research and development of ^{99m}Tc-labelled HEDSPA, from combination of raw materials (phosphorus trichloride and acetic acid) to successful skeletal imaging. The synthetic procedure initially produces 1-hydroxy-ethylidene-1, 1-diphosphonic acid (HEDPHA). Simple and accurate quality control analyses are employed to characterize the HEDPHA. The disodium salt (HEDSPA), which is formed by titrating HEDPHA with sodium hydroxide, is subsequently labelled with $SnCl_2 \cdot 2HOH$ reduced ^{99m}Tc-pertechnetate. Quality control of the labelled pharmaceutical involves the following assays: chemical (85% methanol, descending paper chromatography); physical (Sephadex gel); and biological. The biological assay is based on the earliest time for obtaining a quality bone scan in young and adult rabbits after intravenous administration of 1 mg of ^{99m}Tc-labelled HEDSPA. Toxicity studies in mice resulted in a MLD of 0.2 grams of HEDSPA per kg of body weight. The present scanning dose for humans is approximately 0.5 mg of HEDSPA, representing a safety factor of 1.4×10^4. The MGH has performed approximately 1000 studies without adverse effects. The ease of synthesis of HEDPHA, the superior chemical stability of HEDSPA relative to polyphosphate, and the ease of formulation of ^{99m}Tc-HEDSPA, will greatly increase the magnitude and image quality of skeletal-imaging studies by the nuclear medicine physician. (auth)

26715 SINGLE-STEP KIT OF ^{99m}Tc-LABELLED TIN PYROPHOSPHATE FOR BONE SCINTIGRAPHY: PREPARATION AND CHEMICAL AND BIOLOGICAL ANALYSES. Hegesippe, M.; Beydon, J.; Bardy, A.; Panneciere, C. (CEN de Saclay, Gif-sur-Yvette, France). pp 109-118 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

Work carried out on a new ^{99m}Tc-labelled condensed phosphate complex is described. This compound is shown to be an excellent radiopharmaceutical product for human skeletal scintigraphy and it can be used as a single-step kit. Using Subramanian's labelling method to prepare a bone-seeking compound, the authors conclude from the results of animal scintigraphy that ^{99m}Tc-labelled in pyrophosphate is the best available compound. Moreover, tin pyrophosphate has the advantage of not presenting any preparation problems, unlike other polyphosphates. The composition of the kit was determined on the basis of bioanalytical data obtained by varying the tin/pyrophosphate ratio, the pH, and other parameters. The analytical techniques employed were chromatography on paper, Sephadex G25 and ion exchange resins as well as scintigraphy on rats. An example of human scintigraphy is presented. (auth)

26716 READY-TO-USE KIT FOR THE PREPARATION OF ^{99m}Tc-MACROAGGREGATED ALBUMIN. Kavula, M. P. Jr.; Browne, A. D. (Indiana Univ., Indianapolis). pp 127-130 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

^{99m}Tc-macroaggregated albumin is a useful lung imaging radiopharmaceutical. Reported methods of preparation require the addition of three to seven reagents to a sterile vial. The new method described here requires only the addition of the sodium pertechnetate ($Na^{99m}TcO_4$) to a reaction vial containing all the reagents. A stock suspension of macroaggregated albumin is prepared by diluting 5% human serum albumin (salt poor) in 0.9% sodium chloride injection. This solution is acidified and autoclaved for 15 min to produce the aggregates. Three-milliliter portions of this suspension are placed in 10-ml multiple dose sterile reaction vials. The stock stannous chloride solution ($SnCl_2 \cdot 2H_2O$) is prepared by dissolving 12.5-15.0 mg of the salt in concentrated hydrochloric acid with heat. This solution is then diluted to 100 ml with sterile water for injection that has been previously purged with sterile nitrogen. One milliliter of this solution is added to the reaction vial containing the 3.0 ml of albumin suspension. An 0.8 M phosphate buffer is prepared and 0.15 ml of this solution is added to the reaction vial containing the albumin suspension and tin solution. The ingredients within the vial are stored under a positive pressure of nitrogen. To prepare the ^{99m}Tc-macroaggregated albumin, 5.0 ml of sodium pertechnetate is added and the reaction vial mixed gently for 1 min. The preparation is then centrifuged at 190-200 G for two minutes, and the supernate is taken out in order to remove the hydrolysed technetium, pertechnetate and albumin particles that are less than 5.0 μm in size. The kits are stable for two weeks and labelling efficiency is better than 95%. Animal studies have indicated that the preparation has an adequate disappearance rate from the lung. Excellent routine clinical studies are being experienced with this preparation. (auth)

26717 PREPARATION OF ^{113m}In-FERRIC HYDROXIDE MACROAGGREGATE FOR LUNG SCANNING. Rouhanizadeh, N.; Riazi, L.; Owlya, A.; Khalkhali, Z. (Teheran Univ. Nuclear Centre). pp 131-134 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

The aim of this work was to prepare ^{113m}In-labelled iron hydroxide macroaggregate with pH and particle size suitable for lung scanning. The aggregate was prepared by mixing the required amount of $FeCl_3$ with ^{113m}In followed by the addition of NaCl and coprecipitation of ^{113m}In with Fe^{3+} ions. The final pH was adjusted by gelatine solution and 0.1 N HCl. The prepared aggregates were then analyzed for activity, pH and particle size and injected into rats. The distribution of activity in the lungs, liver, and blood was investigated using scintillation counting. It was found that the grade and concentration of gelatine and the pH

of the solution at the precipitation step are the most significant factors affecting the quality of the macroaggregate. (auth)

26718 ^{99m}Tc-LABELLED ALBUMIN (HUMAN) MICROSPHERES (15-30 μm). Their Preparation, Properties, and Uses. Bolles, T. F.; Kubiatowicz, D. O.; Evans, R. L.; Grotenhuis, I. M.; Nora, J. C. (3M Co., St. Paul). pp 151-167 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

The analysis of regional lung perfusion is now a routine diagnostic nuclear medical procedure through the development of suitable biodegradable radiolabelled particles. Human albumin microspheres are ideal for this use because of their uniform size distribution, stability, pre-testing for sterility and pyrogens, resistance to agglomeration, lung specificity and regulated biodegradability. The availability of a simple, safe, and reproducible method for labelling the microspheres with ^{99m}Tc makes this the agent of choice for lung imaging. The albumin microspheres are prepared by heating a suspension of albumin/water droplets in oil, followed by sizing (15– 30 μm). A simple, hazard-free, labelling system for tagging the microspheres with ^{99m}Tc is described which includes a labelling vial, a semi-automatic labelling and suspending unit, and a microsphere rinsing unit as well as the appropriate shielding. After labelling, the in-vitro rate of dissociation of technetium from the microspheres is less than 1%/hour. The "free" technetium component is shown by thin-layer chromatography to include at least two species. In vivo, the microspheres totally degrade in about 36 h as measured by optically observing the disappearance of the microsphere from mouse lung tissue. A detailed toxicity study of the microspheres is presented. The intravenous LD_{50} for mice and rats is 72.2 mg/kg and 43.8 mg/kg respectively. The MLD is estimated to be 68 mg/kg for the dog and 83 mg/kg for the monkey. Subacute studies in the beagle dog and the Rhesus monkey revealed no significant effects after a total of eight intravenous doses at levels of 1, 7 and 20 mg/kg of body weight. The largest single use of ^{99m}Tc-labelled microspheres is for scintigraphic studies of lung perfusion. After 8375 administrations during clinical trials, only two patients experienced adverse reactions which were possibly drug related. In patients receiving up to eight doses, no hypersensitivity reactions occurred. The further application to studies of the circulation of the heart and of the peripheral system is at present being investigated. (auth)

26719 LABELLING PROCESSES AND SHORT-TERM ^{99m}Tc BIODYNAMICAL BEHAVIOR OF DIFFERENT TYPES OF LABELLED COMPLEXES. Persson, R. B. R.; Strand, S. E. (Univ. of Lund, Sweden). pp 169-188 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

The methods for preparing different ^{99m}Tc-labelled complexes found in the literature show much variation. Results are presented from systematic studies of the optimum conditions for the preparation of ^{99m}Tc-Fe-ascorbic acid, ^{99m}Tc-Fe-DTPA (diethylenetriamine pentaacetic acid) and ^{99m}Tc-Sn-DTPA complexes for use as radiopharmaceuticals. The labelling yields have been studied with thin-layer chromatography and the physiochemical state of the labelled compounds has been studied with gel-column chromatography. The short-term biodynamical behaviour of the different complexes has been studied in rabbits in supine position under a gamma camera with dynamic data-storage and digital display facilities. The retention curves were registered during the first hour after iv administration for heart, liver, and kidneys. The potential clinical use of the different compounds for studying the kidneys from both morphological and functional points of view are discussed. (auth)

26720 FREEZE-DRIED KITS FOR PREPARING RADIOPHARMACEUTICALS FROM ^{99m}Tc. Deutsch, M. E.; Redmond, M. L.; Mead, L. W. (CIS Radiopharmaceuticals, Bedford, MA). pp 189-194 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

A wide variety of radiopharmaceuticals can be prepared from ^{99m}Tc for scanning a wide variety of organs. Except for pertechnetate ion itself, these radiopharmaceuticals include technetium in a form more reduced than in pertechnetate. Kits for preparing them must therefore contain reducing agents that are subject to attack by atmospheric oxygen, and such kits consequently can be made more stable by freeze-drying their components and packaging them in evacuated vials. Additional advantages are then obtained which include a more concentrated product, fewer manipulations (air need not be withdrawn when fluid is added) and the presence of a vacuum as an indicator of vial integrity. In most cases, it is also true that the need for calculation of isotope concentration is obviated since the final product has the same concentration as the pertechnetate solution used to make it. We have prepared such kits for the preparation of technetium sulfur colloid, the technetium chelate of diethylenetriaminepentaacetic acid (uncontaminated by iron ascorbate), technetium polyphosphate, technetium-labelled human serum albumin and technetium-labelled macroaggregated human serum albumin. With the exception of the sulfur colloid for which thiosulphate serves as the reducing agent, all these kits use stannous ion as the reducing agent. Procedures for the preparation and use of these kits are described. In most cases, the radiopharmaceuticals are prepared from the kits simply by injecting sodium pertechnetate solution into the vial of reagent. Stability studies are presented and the results of chemical and biological examinations of scanning agents prepared from the kits, and the physical properties of these agents are compared with those of products obtained by other procedures. (auth)

26721 PREPARATION OF ^{18}F-LABELLED DL-3-FLUOROTYROSINE. Palmer, A. J.; Clark, J. C.; Goulding, R. W.; Roman, M. (Hammersmith Hospital, London). pp 291-302 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

A method of preparing ^{18}F-labelled DL-3-fluorotyrosine is described. ^{18}F is produced by the cyclotron bombardment of neon via the ^{20}Ne(d,α)^{18}F reaction using a glass-lined target vessel. The ^{18}F is recovered in aqueous solution by remote washing of the glass liner, by rotation of the liner with 20 ml of water in it. Detailed operation of the system is described. The ^{18}F activity is introduced into a diazonium tetrafluoroborate derivative of the amino-acid by an exchange reaction in aqueous acetone/acetonitrile solution. The preparation of this diazonium salt, 4-methoxy-3-(2′, 2′-dicarbethoxy-2′-acetamidoethyl)-phenyl diazonium tetrafluoroborate (I) starting from p-methoxybenzyl chloride is fully described. Pyrolysis of the labelled diazonium salt (I) yields ^{18}F-diethyl 3-fluoro-4-methoxybenzylacetamidomalonate (Schiemann Reaction) which is then hydrolyzed to ^{18}F-3-fluorotyrosine by red phosphorus and hydriodic acid. A similar synthesis, starting from L-phenylalanine, has been investigated with a view to preparing ^{18}F-L-phenylanine. Experimental details of the labelling procedure are described and quality control methods for ^{18}F-labelled amino-acids are also discussed. (auth)

26722 SYNTHESIS OF RADIOPHARMACEUTICALS AND LABELLED COMPOUNDS USING SHORT-LIVED ISOTOPES. Wolf, A. P.; Christman, D. R.; Fowler, J. S.; Lambrecht, R. M. (Brookhaven National Lab., Upton, NY). pp 345-381 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

Labelled organic compound preparation in the context of use in the practice of nuclear medicine is reviewed. Accelerator-produced nuclides and radiopharmaceutical production are discussed with examples of pertinent methods of isotope production, methods of incorporation into organic molecules, and the general problems attendant on the production and use of these materials in this new and interdisciplinary effort. The literature is surveyed with stress being given to the use of ^{11}C, ^{18}F, ^{123}I, ^{13}N, and ^{15}O. (auth)

26723 ^{18}F-LABELLING OF BIOACTIVE MOLECULES USING K^{18}F-CH_3COOH SOLUTIONS AS FLUORINATING REAGENT. Mantescu, C. (Inst. of Atomic Physics, Bucharest); Genunche, A.; Simionescu, L. pp 395-404 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

Substitution of fluorine for hydrogen in organic compounds is a unique way to change the electron distribution pattern without substantially changing the shape or size of the molecule. C-fluorinated bioactive molecules are therefore of great interest to the biological sciences. Potassium fluoride is very soluble in glacial acetic acid and the solutions have several unusual properties that promote the release of a F^- solvated anion, the actual

fluorinating species in a good solvent for many organic compounds. ^{18}F obtained via $^{16}O(\alpha,pn)^{18}F$ or $^{16}O(t,n)^{18}F$ nuclear reactions has been introduced into the KF...H-OAc system by distillation or non-aqueous cellulose column chromatography. In these solutions a series of displacement reactions such as epoxide and iodine by the $^{18}F^-$ were easily carried out (at 25°-110°C and 15 min up to 30 min). 2:4 fluoroestrone-^{18}F, 3:5 difluoro-tyrosine-^{18}F, 4-fluoro-testosterone-^{18}F and the polypeptide hormone ocytocin-^{18}F have been obtained. Chemical and radiochemical yields up to 50% were obtained, the separation and purification being achieved by TLC (Silicagel-HR, Cellulose) and ion exchange resins (Dowex 1 × 8). Physico-chemical tests of chemical integrity including uv and ir absorption were used together with the bioanalyses particularly for the fluorinated polypeptide hormone ocytocin. (auth)

26724 [^{18}F] 5-FLUORO-DOPA AS A NEW BRAIN SCANNING AGENT. Garnett, E. S.; Firnau, G. (McMaster Univ., Hamilton, Ont.). pp 405-410 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

DOPA (3,4-dihydroxyphenylalanine) is known to enter intact intracerebral endothelial cells where it is immediately decarboxylated to dopamine and this behavior is specific for the intracerebral capillaries. High concentrations of intracellular dopamine can be achieved by administering L-DOPA together with a monoamine oxidase inhibitor. When intracerebral capillaries are damaged mechanically or electrolytically they lose the ability to concentrate dopamine. The above observations, which were based on fluorescence microscopy studies, suggested to us that if DOPA could be labelled with a suitable γ-emitting isotope, the resulting radiopharmaceutical would provide the first example of a brain specific agent for the diagnosis of intracerebral vascular or neoplastic lesions. In addition, isotopically labelled DOPA might also provide a unique opportunity to investigate the metabolism of the basal ganglia in man by a non-invasive technique. ^{18}F was chosen as a label for DOPA because it was least likely to alter the steric configuration, it had acceptable radiation characteristics and it was likely to be decarboxylated by DOPA-decarboxylase as this enzyme is known to have a broad specificity. To prepare [^{18}F] 5-fluoro-DOPA, an appropriate diazonium fluoroborate (5(2', 2' -dicarbethoxy-2'-acetamidoethyl'-2, 3-dimethoxybenzyl diazonium fluoroborate) was synthesized and allowed to exchange with reactor-produced ^{18}F. The resulting radioactive diazonium fluoroborate was then thermally decomposed and hydrolyzed in acid. [^{18}F] 5-fluoro-DOPA with a specific activity of 35 μCi/mg could be prepared within two half-lives of ^{18}F. 5-Fluoro-DOPA was shown to be decarboxylated by DOPA decarboxylase. Using rabbits, the blood clearance of [^{18}F] 5-fluoro-DOPA was shown to be similar to that of [^{14}C] DOPA, and the amine oxidase inhibitor Nialamide produced a 50% increase in the intracerebral accumulation of [^{18}F] 5-fluoro-DOPA. (auth)

26725 PREPARATION OF ^{18}F-LABELLED FLUOROCARBONS FOR USE IN PHARMACODYNAMIC STUDIES. Clark, J. C.; Goulding, R. W.; Palmer, A. J. (Hammersmith Hospital, London). pp 411-421 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

For many years fluorocarbons, widely used components of aerosol propellents both for domestic and pharmaceutical use and known by a number of proprietary names inclusing "Freon" and "Arcton", were considered to be inert. Recently doubts were cast on this belief and work is being carried out in many centers to investigate the possible causes of the reported toxicity. It was felt that labelled fluorocarbons would be of help in some investigations, and ^{18}F was chosen as having physical properties most suited to the investigations envisaged, namely in-vivo distribution studies using a scinticamera and retention studies using a whole-body counter. ^{18}F-labelled trichlorofluoromethane ("Freon-11") and dichlorodifluoromethane ("Freon-12") were prepared using both silver fluoride $Ag^{18}F$ and silver difluoride $Ag^{18}F_2$. $Ag^{18}F$ and $Ag^{18}F_2$ were both labelled by lining a neon-filled target vessel with carrier AgF or AgF_2. After irradiation with 14-MeV deuterons the neon was removed and the appropriate reactants added to the target vessel by vacuum transfer, the reaction then being carried out at an elevated temperature. The reaction products were removed by vacuum transfer and purified by radio-gas chromatography. The final product was then either diluted with air for rebreathing or transferred by vacuum distillation to aerosol dispensers for placebo administration. (auth)

26726 BIOLOGICALLY ACTIVE ^{18}F-FLUORO-ORGANIC COMPOUNDS. Rapid, High Specific Activity Synthesis of ^{18}F-Fluorocarboxylates and Derivates. Robinson, G. D. Jr. (Univ. of California, Los Angeles). pp 423-432 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

The participation of small ions or molecules in specific metabolic processes is potentially a powerful mechanism for improving the localization of radiopharmaceuticals in target organs. Interest in the preparation of ^{18}F-fluoro-organic agents is due to the strong evidence that the F for H substitution in some biologically active compounds leads to analogues having almost unchanged biological behavior. Potassium fluoride is commonly used to prepare fluoro-organic compounds from the corresponding bromo-, chloro-, or iodo-organics. This interhalogen exchange reaction has been adapted for the synthesis of a series of high specific activity ^{18}F-fluoro-organic compounds. ^{18}F-fluoride in aqueous solution is prepared by the $^{16}O(^3He,p)^{18}F$ reaction on water in our Biomedical Cyclotron facility. The ^{18}F-fluoride is absorbed on anion exchange resin ("Dowex 1-4X", fluoride) and dried under vacuum at 40°C. This dry ^{18}F "reagent" is then sealed in a glass ampule with an appropriate ethyl halocarboxylate and reacted at elevated temperature (<180°C) for up to 90 min. After cooling, the ampule is opened and the labelled product (ethyl ^{18}F-fluorocarboxylate) is isolated by gas chromatography. Hydrolysis of the product gives labelled carboxylic acid, whereas reduction gives labelled alcohol. Reaction of the free carboxylic acid with $SOCl_2$ gives the highly reactive acid chloride. Radiochemical yields vary from 10 to 40% with "available" yields ranging from 3 to 20%. Specific activities range from 5 to 20 mCi/mg (available). The ^{18}F-labelled analogue molecules are currently being tested in animals as potential radiodiagnostic agents, primarily as tracers for rapid, dynamic metabolic functions. The lipid-soluble compounds (2-fluorobutyrate, 2-fluorotetradecanoate 2-fluoroethanol, etc.) are expected to show promise as agents for the evaluation of regional brain perfusion due to the apparent absence of a blood-brain barrier for many such substances. The medium and long chain fatty acids (2-fluorohexanoate, 2-fluorotetradecanoate, etc.) are being evaluated as potential agents for myocardial imaging and liver function studies. As a result of their relatively non-specific, high tissue extractability, fluoroacetate and 2-fluoroethanol show promise as agents for the measurement of fractional cardiac output. In addition, ^{18}F-fluoroacetyl chloride has considerable potential for use in the rapid preparation of a wide variety of high specific activity compounds, such as fluoroacetylsalicylic acid (an asparin analogue) and cholesteryl fluoroacetate. (auth)

26727 SYNTHESIS AND EVALUATION OF ^{11}C-LABELLED ORGANIC COMPOUNDS FOR USE IN NUCLEAR MEDICINE. Winstead, M. (Bucknell Univ., Lewisburg, PA); Lin, T. H.; Khentigan, A.; Lamb, J.; Fleischer, A.; Winchell, H. S.; Myers, W. pp 451-460 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

Large quantities of ^{11}C-labelled compounds can be synthesized and their in vivo distribution imaged by gamma scintigraphy using positron cameras, rectilinear scanners or gamma cameras using high-energy multi-hole or pin-hole collimators. Organic compounds which are not normal body constituents are usually excreted from the body by the kidneys or the liver with excretion products appearing in urine or bile respectively. Our results do not differentiate between direct excretion by these organs or excretion after conjugation or alteration in the body. In general, compounds containing polar moieties and possessing high water solubility are largely excreted by the kidneys whereas those compounds containing non-polar, lipid soluble moieties are largely excreted by the liver. Whether the liver or kidney is the organ most responsible for excretion of a given compound also depends on its degree of in vivo conjugation, a parameter which was not measured. ^{11}C-acetate, propionate, butyrate, isobutyrate, hexanoate, heptanoate and octanoate all showed initial accumulation of activity in liver and diffusely throughout abdomen, variable retention of activity in heart-blood pool followed by an increase in homogeneous body activity with time. This distribution pattern may reflect equilibration of these materials with fatty tissues having high perfusion rates such as

lipids in liver and mesentery where they may be catabolized to other moieties such as CO_2. 5,5-hexamethylenehydantoin, 5, 5-diphenylhydantoin (Dilantin), 5-ethyl-5-phenylhydantoin (Nirvanol), and 1, 5-diphenylhydantoin all showed evidence of localization within the brain within 5 to 10 min after their iv administration. Of the nitriles studied, α-(anilino)-phenylacetonitrile and α-(parachloroanilino) phenylacetonitrile showed the most marked accumulation of activity in the brain and this appeared to occur maximally within minutes following their iv injection. It is postulated that those materials may actually be accumulating in the lipoprotein membrane of the capillary cell wall of the brain having somehow previously cleared the pulmonary capillary bed. The mechanism for such localization in the brain remains to be elucidated. However, from the rapidity of localization of activity in the brain following iv administration of these compounds, it appears probable that such localization is blood flow dependent; the possibility exists that related compounds may be found to be useful in differentiating vascular lesions (e.g. neoplastic) from avascular lesions (e.g. cerebral infarcts) of the brain in clinical studies. (auth)

26728 SYNTHESIS AND METABOLISM OF ^{11}C-CHLORPROMAZINE METHIODIDE. Comar, D.; Maziere, M.; Crouzel, C. (Service Hospitalier Frederic Joliot, Orsay, France). pp 461-469 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

Of the short-lived radioelements produced in cyclotrons, ^{11}C ($T_{1/2}$ = 20 min) occupies a privileged position in that it is easily obtained in quantity as $^{11}CO_2$ or ^{11}CO and can be used directly in human subjects for investigating pulmonary function or, after incorporation in a natural or synthesized organic molecule, as a medical diagnostic agent or as a means of investigating the metabolism of a medicinal agent. Synthesis of ^{11}C-chloropromazine methiodide involves the following stages: continuous production of $^{11}CO_2$ by bombarding nitrogen containing 4% oxygen with 16.5 MeV protons, the radioactivity obtained being of the order of 2 mCi/μA per min; conversion of $^{11}CO_2$ into methanol using the reaction scheme described by Nystrom; conversion of $^*CH_3OH$ into I^*CH_3 by reaction with hydriodic acid; synthesis of chlorpromazine methiodide through the action of gaseous I^*CH_3 on excess chlorpromazine in solution in tributyl phosphate. These reactions are performed continuously until after less than 40 min several millicuries of I^*CH_3 are produced. The yield of the synthesis was measured and the radiochemical purity was controlled at each stage by gas chromatography and thin-layer chromatography using silica gel. The chlorpromazine methiodide produced was dissolved in physiological solution, sterilized by Millipore filtration and injected intravenously into rabbits. The sequential images obtained with a gamma camera as well as the qualitative distribution of the molecule between different organs are presented. (auth)

26729 RAPID INCORPORATION OF SHORT-LIVED CYCLOTRON-PRODUCED RADIONUCLIDES INTO RADIOPHARMACEUTICALS. Lathrop, K. A.; Harper, P. V.; Rich, B. H.; Dinwoodie, R.; Krizek, H.; Lembares, N.; Gloria, I. (Univ. of Chicago). pp 471-481 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

The advantages of short-lived radionuclides for clinical use have become well known through their availability from generators. Applications for other short-lived radionuclides produced with a compact cyclotron are being found in a number of laboratories. The cost of such a facility, comparable with that of a cardiac catherization laboratory, is within reach of major hospitals, and could be reduced considerably if limited to a service rather than research machine. Production methods for two sterile, pyrogen-free preparations of 10-min ^{13}N have been developed, and used clinically in our laboratories. Nitrogen-13 is produced by the $^{12}C(d,n)^{13}N$ reaction on methane or by the $^{16}O(p,\alpha)^{13}N$ reaction on gaseous oxygen or on water. It is converted to $^{13}NH_4^+$ and used directly for myocardial localization, or is utilized as a substrate for the enzymatic synthesis of L-glutamate which shows some promise for visualization of the pancreas. The $^{13}NH_4^+$, when used for myocardial studies, may be rapidly prepared for intravenous injection from ^{13}N produced by either method. As many as 30 mCi are available for injection within 10 to 15 min after the end of bombardment. Clinical trial in more than 50 cardiac patients shows good delineation of the normal left myocardium and an absence of localization correlated with infarcted areas. Qualitative tissue distributions determined from scintiscan intensities appear to be in good agreement with quantitative data obtained for mice. Calculations of radiation absorbed doses from the latter data show that the largest dose, about 25 mrad per mCi injected, is to the liver and kidneys. A sterile pyrogen-free solution of ^{13}N-glutamate may be produced by enzymatic reaction of $^{13}NH_4^+$ in Tris-buffer at pH 8 with NADPH and alpha ketoglutarate. The reaction mixture is incubated for 8 min at 25°C, boiled at pH 10 to remove unreacted $^{13}NH_3$ and to coagulate protein, and passed through a 0.2 μm membrane filter to sterilize and to remove protein. The reagents are mixed in the cyclotron vault. The solution incubates during transportation to the scanning laboratory where it is boiled, filtered and injected. The pancreas/liver ratio for ^{13}N is around 2.5:1 in laboratory animals and appears to correspond in the human. This ratio is similar for ^{75}Se-L-selenomethionine, but the higher count-rates obtainable with ^{13}N should give improved images of the pancreas. Acetate labelled in the carboxyl position may be prepared by the Grignard reaction with $^{11}CO_2$, which is produced by the $^{13}N(p,\alpha)^{11}C$ reaction on gaseous nitrogen containing a trace of oxygen. Exploratory studies in the baboon and human indicate that information may be obtainable with this radiopharmaceutical about metabolic rates in various organs. One such study on the human myocardium gave a retention time of 3.3 min, the disappearance of radioactivity presumably reflecting metabolism. Each of these radiopharmaceuticals is prepared in a system that yields sterile, pyrogen-free solutions. Insofar as possible, pre-tested reagents are used. All glassware contacted has been cleaned by soaking in 2N NaOH for at least one hour, then thoroughly rinsed in water for injection, and sterilized either by drying at 250°C or by steam. The solution is also sterilized terminally by passage through an 0.2 μm sterile membrane filter. (auth)

26730 PRODUCTION OF ^{13}N-LABELLED AMINO-ACIDS BY ENZYMATIC SYNTHESIS. Cohen, M. B.; Spolter, L.; MacDonald, N.; Masuoka, D. T.; Laws, S.; Neely, H. H.; Takahashi, J. (Veterans Administration Hospital, Sepulveda, CA). pp 483-490 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

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The rapid enzymatic preparation of ^{13}N-labelled L-glutamine and L-glutamic acid is described. $^{13}NH_3$ was produced in the AEC-funded UCLA Biomedical Cyclotron by irradiation of either methane or an aluminium carbide target in a (d,n) reaction. The $^{13}NH_3$ was separated from methane by use of a water trap containing 2×10^{-5}M carrier ammonium acetate or was separated from aluminium carbide by distillation. An aqueous solution was then added to incubation tubes containing the enzyme, substrate, buffer and co-factors. ^{13}N-labelled L-glutamine was synthesized after a 10-min incubation at 37°C, and L-glutamic acid was synthesized after a 5-min incubation at 25°C. The reaction vessel was then immersed in ice to halt the enzymatic reaction. L-glutamine synthetase (EC 6.3. 1.2) and L-glutamic acid dehydrogenase (EC 1.4. 1.2) were used in respective syntheses. ^{14}C-labelled substrates were used to provide a doubly labelled product for analytical purposes including whole-body radioautography of mice. Rapid paper chromatography and column chromatography were also employed for analyses of ^{13}N-compounds. The ^{13}N-labelled L-glutamine and L-glutamic acid as produced by the above methods are suitable for animal studies. Pharmaceutical quality ^{13}N-labelled glutamic acid has been produced on a demonstration basis by use of a negatively charged Dowex 50 column, which adsorbs free ammonia and organic amines. The column also apparently adsorbed or slowed the movement of the enzyme. The product was passed through a 0.22-μm Millipore filter and found to be sterile, pyrogen-free and free of enzyme, as measured by the Lowry technique. Organ distribution studies were performed in mice and rabbits sacrificed 5 min after the iv injection of ^{13}N-L-glutamic acid. At this time interval, the maximal uptake in counts/min per mg measured in a well counter was found in the kidney, pancreas and liver with a lesser amount in the heart. These findings were confirmed in mice by whole-body radioautography and in rabbits by the scintillation camera. The feasibility of producing a ^{13}N-labelled compound by enzymatic synthesis has been demonstrated. The technology developed in these studies will be extended to production of other ^{13}N- and ^{11}C-labelled compounds. (auth)

26731 LABELLING OF TOLUIDINE BLUE WITH ^{35}S AND WITH ^{38}S. Lindner, L.; Simonov, E. F.; Visser, J.; Veenboer, J. T. (Inst. for Nuclear Physics Research, Amsterdam). pp 491-499 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

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The dye toluidine blue is of interest for medical application in the diagnostic field. The molecular structure of this compound comprises a sulfur bridge between two aromatic rings. Labelling with the pure beta emitter ^{35}S($T_{1/2}$ = 87 d) has been reported previously by others. However, for external scanning purposes the need was felt to label with a gamma-emitting nuclide. As it was shown in this laboratory that ^{38}S($T_{1/2}$ = 2.9 h, E_γ = 1.9 MeV) could be produced in useful amounts, we preferred labelling with this isotope over labelling with ^{18}F as suggested by others. The procedure described is based on the classical recipe using thiosulfate labelled in the peripheral sulphur atom ($^*SSO_3^-$). In view of the short half-life, the main problems to overcome were speeding up the synthetic procedure as well as producing a product of adequate chemical purity and specific activity. ^{35}S was used to test the various steps. (auth)

26732 PREPARATION AND ^{99m}Tc-LABELLING OF HUMAN ALBUMIN MICROSPHERES OF DIAMETER 1-4 μm FOR DYNAMIC STUDIES AND LUNG SCINTIGRAPHY. Giuntini, G. (Centre National de la Recherche, Pisa, Italy); Pasqualini, R.; Santolicandro, A.; Piassio, G.; Villa, M. pp 65-75 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

Human albumin microspheres labelled with ^{99m}Tc or ^{113m}In are among the more important radiopharmaceuticals in nuclear medicine. After vascular injection, they are arrested in the capillary system of the organ or organs located immediately downstream of the point of injection. Administered in the form of aerosols, they are deposited in the pulmonary alveoli. The most important factors affecting the in vivo behavior of the microspheres are diameter and surface properties (effects of aggregation). The preparation technique for obtaining homogeneous fractions of albumin microspheres of diameter 1-4 μm is described, together with methods of ^{99m}Tc-labelling with high efficiency (80-90%), and the results obtained using microspheres in vivo. Employing a technique studied in their laboratory, the authors have developed the following preparation method: an emulsion of albumin and polyaminoacids in vegetable oil is changed into a gel by heating, and the microspheres of diameter 1 μm and 10 μm respectively are separated by gradient centrifuging; the microspheres prepared in this way have an average diameter of 3.5 μm and 9 μm. All the parameters of importance for obtaining the most reactive microspheres have been examined; the labelling techniques adopted are also discussed in detail. The use of 1-4 μm microspheres administered in the form of aerosols is of great importance for studies on all diseases of the respiratory system. (auth)

26733 QUALITY CONTROL PROBLEMS WITH PARTICLE SUSPENSIONS FOR LUNG SCINTIGRAPHY. Mueller, T..; Andersen, K. W. (National Health Serivce of Denmark, Copenhagen). pp 77-88 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

Many different particle suspensions labelled with radioactive isotopes are used as radiopharmaceuticals for lung scintigraphy. Because of the special morphology of the lungs, there are many different views regarding the maximum permissible particle size in these preparations. Some of the preparation methods described in the literature do not always result in particle suspensions with well-defined and consistent particle sizes from preparation to preparation. Besides being commercially available, these suspensions are often prepared on site at the hospitals, and there seems to be an obvious need for them to be submitted to a quality control check for maximum particle size before use. Several commonly used control methods are discussed and a quick, easy and reasonably safe control method for the proportion of over-size particles to be expected in the whole batch is presented in order to assign a degree of quality to the single preparation as part of the total judgement of the suitability of the individual preparation for human application. (auth)

26734 LABELLED COMPOUNDS FOR RADIOIMMUNOASSAY PROCEDURES. Rosa, U.; Malvano, R. (National Research Council, Pisa, Italy). pp 91-104 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

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A review is made of the present state of labelling techniques for the preparation of tracers used in radioimmunoassay (RIA). Radioimmunoassay has been originally limited to large proteic hormones using their radioiodinated derivatives as tracers. In recent years the technique of raising antisera against small hormonal haptens using their conjugates to a proteic support as immunogen, has opened the way to the radioimmunoassay of new classes of compounds (steroids, drugs, etc.) whose tritiated derivatives have been used as tracers. However, it has been found that radioiodination of the conjugates of the haptens yields compounds which can replace in radioimmunoassay the tritiated tracers with obvious advantages in cost and operative simplicity. In the context of this review special emphasis will therefore be given to the problems connected with preparation and use of radioiodinated tracers. The present state of the knowledge will be discussed with regard to the requirements for a tracer to be used in RIA (effect of the quality of the tracer on the assay sensitivity; choice of the specific activity); the labelling and purification of proteic hormones and polypeptides; and the synthesis and labelling of the TME (tyrosyl methyl ester) conjugates of steroids and drugs. (auth)

26735 METHOD OF STABILIZING ^{125}I-INSULIN AND ^{125}I-STH. Sadowska, B.; Proszynska, K.; Barczak, A. (Institut de Recherches Nucleaires, Swierk, Poland). pp 105-108 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

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The immunological activity of ^{125}I-insulin and ^{125}I-STH was examined for three weeks after labelling. Some of the hormones were stored in solution at a temperature of +4°C and the others were lyophilized. In each experiment the maximum percentage of hormone complexing with the antibodies was determined and a standard curve drawn. It was found that lyophilization does not have a negative effect on the immunological activity of insulin and STH labelled with ^{125}I. (auth)

26736 PREPARATION OF TRITIUM-LABELLED PEPTIDIC HORMONES OF HIGH SPECIFIC RADIOACTIVITY. Morgat, J. L.; Formageot, P. (CEN de Saclay, Gif-sur-Yvette, France). pp 109-119 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

Work on describing the physiological effects of hormones has gradually led to the study of their influence on metabolic processes at the molecular level. Examination of the molecular interactions responsible for the biological action of hormonal peptides entails specific detection of the peptides at their action site. Only by using radioactive hormones can one hope to detect them and measure their concentrations, and thereby gain an experimental understanding of their action mechanisms. Various tritiation techniques which preserve all the biological properties of polypeptidic hormones are described and discussed. The biological behavior of the iodated derivatives whose preparation is one of the tritiation stages is also discussed. (auth)

26737 LABELLING OF MOLECULAR HSA AND MACRO-AGGREGATES WITH RADIOIODINE. Hallaba, E.; El-Wetery, A. S.; Azzam, R. (Atomic Energy Establishment, Cairo). pp 123-139 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

The labelling of HSA by the iodine monochloride and the chloramine-T methods has been extensively investigated. The effect of the ratio of these iodinating agents in relation to protein has been studied. It has been noticed that to achieve good labelling with ICl at a low protein : ICl ratio (1 : 1) a pre-oxidation step is ultimately necessary. With the chloramine-T method to achieve high labelling with similar ratio a high concentration of chloramine-T is necessary. The effect of carrier KI and HSA concentration on the yield of labelling has also been studied. A minimum concentration of KI as well as of HSA are necessary. The chloramine-T method presents itself as a simple and attractive method with high yield of labelling and very convenient for routine production in medical laboratories. Purification by passing through anion exchange resin and dialyzing for 3-4 h is sufficient to remove most of the free iodide and peptide residues. Molecular human serum albumin can be converted to macroaggregates by

a combination of heat treatment and pH adjustment. These aggregates are of increasing use in medical scanning. To obtain aggregates of the desired size in aqueous medium, change in the pH of the albumin solution as well as the temperature of heating, time and degree of agitation are all contributing factors. Similarly HSA can be converted to microspheres of the desired micron size by emulsifying an albumin solution in oil and then pouring this mixture into well-stirred heated oil. The oil is then extracted with ether and the dry pure albumin powder is stored at 4°C for further labelling. The effect of different parameters of emulsification and baking have been studied, and recorded by microscopic examination. (auth)

26738 METHYLATED RADIOSELENIUM COMPOUNDS: THEIR SYNTHESIS, METABOLISM AND PRACTICAL USE. Parizek, J.; Benes, J. (Inst. of Biological Research, Prague). pp 141-144 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

It is well established that methylated selenium compounds, dimethylselenide and trimethylselenonium ions, can be formed in the organism. In addition to the possible relation of these compounds to the biological role of selenium as a known essential trace element, these compounds are of interest with regard to their excretion, dimethylselenine being excreted mainly by respiration and trimethylselenonium ion in urine. A very high uptake of ^{75}Se by the kidneys of animals given ^{75}Se-dimethylselenide or ^{75}Se-trimethylselenonium salts, as well as the sex-linked difference in the retention of ^{75}Se in these kidneys, seem to be of interest from the point of selenium metabolism, and also for the possible use of these compounds in assessments of renal function. Dimethylselenide has been shown to be converted into trimethylselenonium ions in the organism and renal retention in this latter form has been shown to be influenced by androgenic and/or anabolic renotropic hormones. This interesting relationship to kidneys might open new possibilities for functional renal diagnosis, particularly as these compounds could be labelled with ^{75}Se or with ^{72}Se. The half-life of either of these isotopes and the characteristic radiation would make possible the use of these compounds in animal experiments and also in clinical practice. We have used ^{75}Se-labelled compounds only in animal experiments. However, the chemical procedures have been worked out keeping in mind the preparation and use of similar compounds labelled with short-lived isotopes of selenium. ^{75}Se-dimethylselenide was prepared by direct reduction of elementary selenium with sodium in liquid ammonia and then by alkylation of natrium selenide with methyliodide. The reported method was modified for the work with small amounts of relatively highly volatile labelled compounds and having regard to the high toxicity of some intermediates. Alkylation of dimethylselenide with methyliodide affords trimethylselenonium iodide, its reaction with $AgBF_4$ resulting in $(CH_3)_3$ $SeBF_4$. This trimethylselenonium salt reacting with potassium salt of an organic acid (e.g., kalium citrate, gives trimethylselenonium citrate. Radiochemical purity of the compounds described was checked by gas chromatography (dimethylselenide) and elution and paper chromatography (trimethylselenonium compounds). The stability of the compounds was checked in the same way. Experiments in rats revealed that administration of small amounts of ^{75}Se-trimethylselenonium salts would open up new possibilities for radioisotope renography. In comparison with ^{75}Se-dimethylselenide, ^{75}Se-trimethylselenonium salts are highly preferable from the point of view of administration, metabolism and chemical stability in solutions. The physiological qualities of ^{75}Se-trimethylselenonium ions, including the favorable biological half-life, make these compounds highly promising for clinical evaluation of renal functions. (auth)

26739 METHOD FOR DETERMINING THE RADIOCHEMICAL PURITY OF ^{169}Yb-EDTA. Kovach, A. (State Inst. for Pharmacy, Budapest). pp 145-150 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

The advantageous physical and biological properties of ^{169}Yb chelates, ^{169}Yb-DTPA and, recently, ^{169}Yb-EDTA, make them suitable for widespread application in human diagnostics. ^{169}Yb-EDTA has an important role in renal and cerebral diagnostics. From the point of view of diagnostics the radiochemical purity of the preparation is of major importance. A paper chromatographic procedure has been elaborated to determine the radiochemical purity of the preparation. The mixture of 0.025 M ammonium sulfate:acetone:10% ammonia solution (100:50; 0.10) has proved to be the most suitable for the development of the chromatograms. Development is carried out with the ascending technique for 5 h. The ionic $^{169}Yb^{3+}$ can be located at R_f 0.0, ^{169}Yb-EDTA at R_f 0.77-0.85. The applied solvent mixture does not interfere with the stability of the complex. Distribution of activity is determined by a Packard Auto Gamma Spectrometer. (auth)

26740 CHELATION OF RADIOACTIVE CATIONS BY A POLYPEPTIDE: BLEOMYCIN. Renault, H.; Henry, R.; Rapin, J.; Hegesippe, M. (INSERM, Paris). pp 195-204 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

Under specific conditions certain polypeptides can chelate cations. This property has been used, in conjunction with an antitumoural agent, ^{57}Co-labelled Bleomycin, to show up malignant tumors and their metastases. In order to use ionizing radiation in extending the application of Bleomycin from the diagnostic to the therapeutic field and to investigate the optimum labeling conditions for a polypeptide, various mono-, di- and trivalent cations were chelated with Bleomycin. In each case the radioactive cation was separated as a salt or chelate by filtering through a column of carboxylic ion exchange resin (IRC 50). The studies showed that it is largely copper, nickel, cobalt and zinc, and to a lesser extent divalent iron and mercury, which are chelated. The alkaline-earth metals and the trivalent metals are hardly bound at all. Thus there is a preferential binding with divalent metals and in particular those belonging to the group of transition metals. These are the metals which should be investigated to find one with emission characteristics favoring the use of labelled Bleomycin in radiotherapy. (auth)

26741 SYNTHESIS OF SOME DEOXY HEXOSES. Soukupova, V. (Institutes for Biological Research, Prague); Veres, K.; Benes, J.; Cerny, M. pp 231-237 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

The synthesis of 2-deoxy-, 4-deoxy-, 6-deoxy-D-glucose by catalytic dehalogenation with Raney nickel or with Pd/C corresponding iododerivatives obtained when cleaving the epoxides with magnesium iodide or replacing the tosyloxy group with iodine is described. In the case of 2-deoxy- and 4-deoxy-D-glucose, the starting compounds were 4-O-benzyl-1, 6:2, 3-dianhydro-β-D-glucopyranose and 1, 6:3,4-dianhydro-2-O-p-toluenesulphonyl-β-D-glucopyranose, their half-acetal group being suitably protected with 1, 6-anhydro-bond. After cleavage of the oxiran cycle the trans-iodohydrins formed were catalytically dehalogenated to appropriate deoxy derivatives. The protecting benzyl group was removed by direct catalytic debenzylation and the p-toluene-sulpho group by cleaving with sodium amalgam, after previous protection of the 3-OH group in the form of tetrahydropyranyl ether. Reducing deoxy sugars were prepared by acid hydrolysis of 1, 6-anhydroring. The starting material for the synthesis of 6-deoxy-D-glucose is 1, 2, 3, 4-tetra-O-acetyl-6-O-p-toluenesulphonyl-α, β-D-glucose, synthetized by direct tosylation of glucose in the position 6 and the following acetylation. This derivative in reaction with sodium iodide in acetanhydride affords 6-iododerivative of glucose appropriately acetylated. By catalytic dehalogenation the 6-deoxy derivatives was obtained which was then deacetylated to free sugar. The method described was successful also when synthetizing tritiated deoxy-D-glucoses; radioactive preparations with high specific activity and radio-chemical purity were obtained when using tritium gas and N, N-dimethyl acetamide as a solvent. Because the starting iodo derivatives are relatively easily available and also the synthesis of deoxy sugars affords good yields, the method described can be used also for the synthesis of other deoxy sugars. (auth)

26742 ORGANIC SYNTHESIS AND BIOSYNTHESIS OF ^{13}C-LABELLED COMPOUNDS FOR CLINICAL INVESTIGATIONS. Ott, D. G.; Gregg, C. T.; Kerr, V. N.; Kollman, V. H.; Whaley, T. W. (Los Alamos Scientific Lab., NM). pp 267-279 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

There are many similarities between syntheses with radio-

isotopes and syntheses with stable isotopes; however, there are often quite different problems presented. These are primarily because of the difference in scale of the preparations, which is usually considerably larger for the stable isotopes. Many of the elegant schemes which have been developed over the past two decades for isotopic labelling with ^{14}C are not applicable to ^{13}C at all–they do not scale up satisfactorily. The synthesis of compounds labelled with stable isotopes often necessitates development of new methods and considerations which do not ordinarily arise in preparations of normal or radioactive compounds. Other unique factors are associated with stable isotope labelling. These compounds exhibit differences from their isotope isomers in physical properties normally not encountered with radioactive labelling (e.g., density, molecular weight, and infrared and nuclear magnetic resonance spectra). These properties can often be used in analytical procedures necessary in developing synthetic methods and characterizing products. ^{13}C nuclear magnetic resonance is very useful; it should also be noted that proton NMR can be used for studying ^{13}C. The concepts of multiple labelling and isotope isomers become quite important for using compounds labelled with stable isotopes. Organic syntheses developed or adapted for the relatively large-scale preparation of ^{13}C-labelled organic intermediates (about 90 at. % ^{13}C) for preparing compounds of medical interest are discussed. These include methanol (from catalytic hydrogenation of carbon dioxide); carboxylic acids (by catalytic carbonylation of alcohols), in particular the isotope isomers of acetic acid; hydrogen cyanide (from formamide and from methane and ammonia); acetylene (from carbon dioxide and lithium); benzene (by polymerization of acetylene); formates and formamides (from carbon monoxide); and urea (from carbon monoxide and ammonia). Bio-synthetic production of glucose, fructose, sucrose and starch, uniformly labelled with ^{13}C, through photosynthesis by excised leaves of tobacco (obtained by hydroponic culture in a normal atmospheric environment) is discussed. Similarly, galactose-U-^{13}C and glycerol-U-^{13}C are obtained photosynthetically from thalli of the red kelp Gigartina corymbifera. (auth)

26743 ABSORPTION SPECTRA OF DILUTE SOLUTIONS OF $ZrCl_4$ AND $ThCl_4$ IN MOLTEN ALKALI METAL CHLORIDES. Smirnov, M. V.; Chentsova, G. V. Tr. Inst. Elektrokhim., Ural. Nauch. Tsentr. Akad. Nauk SSSR; No. 20, 16-19(1973). (In Russian).

The temperature dependence of the electron absorption spectra of dilute $ZrCl_4$ and $ThCl_4$ in molten Na, K, and Cs chlorides was studied. The maximum absorption wave in all systems studied was in the region 270-600 nm and was linearly displaced toward the long-wave region with increase in the inverse of the radius of the alkali metal cation. At the same temperature in a given salt medium, the $ZrCl_2$ waves were in a longer wave region than those of $ThCl_4$. (tr-auth)

26744 NATURE OF THE ELECTRON ABSORPTION SPECTRA OF DILUTE $ZrCl_4$ AND $ThCl_4$ IN MOLTEN ALKALI METAL CHLORIDES. Smirnov, M. V.; Khaimenov, A. P.; Chentsova, G. V. Tr. Inst. Elektrokhim., Ural. Nauch. Tsentr. Akad. Nauk SSSR; No. 20, 20-22(1973). (In Russian).

The absorption spectra of dilute $ZrCl_4$ and $ThCl_4$ solutions in molten alkali chlorides are considered. Starting with approximations of the crystalline field in the jl bond, the displacement of the absorption band with change in temperature and radius of the cation salt solvent is explained. The absorption bands observed are due to the electron transitions $4p^56f \rightarrow 4p^55s$ for $ZrCl_4$ and to $6p^58f \rightarrow 6p^57s$ for $ThCl_4$. (tr-auth)

26745 VOLATILITY AND ACTIVITY OF $ThCl_4$ AND CsCl IN THEIR MOLTEN MIXTURES. Smirnov, M. V.; Khudolozhkin, V. N.; Kudyakov, V. Ya.; Sherstobitova, I. A. Tr. Inst. Elektrokhim., Ural. Nauch. Tsentr. Akad. Nauk SSSR; No. 20, 27-32 (1973). (In Russian).

The volatilities of the saturated vapors of the components of the binary salt system CsCl–$ThCl_4$ containing 0 to 50 mole % $ThCl_4$ were determined at temperatures from 870 to 1240°K. From the tensimetric data measurements, the temperature and concentration dependence of the thorium and cesium chloride activity coefficients were determined; the values indicated a significant deviation of the salt mixture from ideal behavior. (tr-auth)

26746 THERMODYNAMICS OF $ThCl_4$ SOLUTIONS IN MOLTEN K AND Cs CHLORIDES. Smirnov, M. V.; Kudyakov, V. Ya.; Khudolozhkin, V. N. Tr. Inst. Elektrokhim., Ural. Nauch. Tsentr. Akad. Nauk SSSR; No. 20, 33-36(1973). (In Russian).

The partial enthaply, Gibbs energy, and excess Gibbs energy in the displacement of molten $ThCl_4$ with KCl and CsCl deviated considerably from the ideal owing to formation of complex anions of the type $ThCl_n^{(n-4)-}$. The very small negative deviation of these values for alkali metal chlorides in dilute $ThCl_4$ solutions indicate the practically ideal behavior of the thorium complex formed in excess salt-solvent. The maximum deviation of the total thermodynamic values is in the vicinity of about 33 mole % $ThCl_4$. (tr-auth)

26747 ELECTROCHEMICAL BEHAVIOR OF THORIUM IN MOLTEN ALKALI METAL CHLORIDES. Kudyakov, V. Ya.; Posokhin, Yu. V.; Smirnov, M. V.; Krasnov, Yu. N. Tr. Inst. Elektrokhim., Ural. Nauch. Tsentr. Akad. Nauk SSSR; No. 20, 37-41(1973). (In Russian).

The equilibrium electrode potential of thorium relative to its ions was measured in dilute lithium and cesium chlorides as a function of temperature and concentration. It was shown that metallic thorium in an equilibrium mixture of its di- and tetravalent ions is reversible. The values under standard conditions of the electrode potentials Th(II)/Th, Th(IV)/Th, and Th(IV)/Th(II) are related to the radius of the cation of the salt-solvent. Empirical linear equations were found that describe their changes with temperature and cation radius. Upon changing from LiCl to CsCl, the higher valent form is stabilized and the equilibrium reaction constant of reduction of $ThCl_4$ to $ThCl_2$ decreases. (tr-auth)

26748 DIFFUSION COEFFICIENTS OF TRIVALENT URANIUM IN MOLTEN ALKALI METAL BROMIDES AND IODIDES. Komarov, V. E.; Smirnov, M. V.; Borodina, N. P. Tr. Inst. Elektrokhim., Ural. Nauch. Tsentr. Akad. Nauk SSSR; No. 20, 47-50 (1973). (In Russian).

By a chronopotentiometric method, the diffusion coefficients of trivalent uranium in molten NaBr, NaI, KBr, KI, CsBr, and CsI were measured at temperatures from 939 to 1166°K. It was shown that the rate of diffusion of U^{3+} ions in molten bromides and iodides, as in chlorides, is decreased in going from sodium to cesium. The effect of the salt-solvent cation in bromide and iodide melts is less than in chlorides. The effect of the anion environment related to the total cation of the salt medium is most strongly expressed in the case of sodium and the least in the case of cesium. (tr-auth)

26749 DEACTIVATION PROCEDURE FOR SODIUM AND FOR STORAGE OF IRRADIATED FUEL ELEMENTS. Heylen, J. R. Belgian Patent 802,637. 16 Nov 1973. 13p. (In French).

A procedure for the deactivation of sodium and/or for the storage of irradiated fuel elements is described. In this procedure the fuel elements are placed in contact with a mixture of fused salts. These fused salts are non-corrosive for the stainless steel of the fuel elements. They are inert to the oxides of U and Pu at the deactivation temperature. They react with the metallic sodium without production of explosive gas. (tr-auth)

26750 METHOD OF PRODUCING $NaF \cdot 2UF_4$. Briggs, G. G. (to United States Atomic Energy Commission). US Patent 3,778,500. 11 Dec 1973. Filed date 23 May 1972. 8p.

A method is described for the production of uranium metal from uranyl nitrate or uranyl chloride with an intermediate product of $NaF \cdot 2UF_4$. (Official Gazette)

26751 RADIOCHEMICAL STUDIES ON AGED OR IRRADIATED THORIUM ACETYLACETONATE BY SUBLIMATION METHOD. Kawazu, H.; Sakanoue, M. (Kanazawa Univ., Japan). Radiochem. Radioanal. Lett.; 16: No. 6, 363-371(23 Mar 1974).

Vacuum sublimation was performed on an aged thorium acetylacetonate for studying the behavior of the daughter nuclides in the thorium decay series. The purified thorium acetylacetonate was irradiated with either reactor neutrons or 14-MeV neutrons and sublimed after irradiation to examine the behavior of ^{233}Th and ^{233}Pa or ^{231}Th. ^{233}Th sublimed as its acetylacetonate, ^{233}Pa did not sublime at all. A high enrichment of β^--ray emitting thorium isotope, ^{231}Th (T = 25.6 hr), was accomplished by this method. (auth)

26752 RADIOCHEMICAL STUDIES ON URANYL ACETYLACETONATE BY SUBLIMATION METHOD. Amano, R.; Sakanoue, M. (Kanazawa Univ., Japan). Radiochem. Radioanal. Lett.; 16: No. 6, 381-385(23 Mar 1974).

The separation of ^{234}Th from its parent ^{238}U was successfully made by subliming the aged uranyl acetylacetonate. A large portion of ^{234}Th (about 94% produced by the decay of ^{238}U) remained in the residue. The fresh acetylacetonate of ^{234}Th simultaneously prepared with uranylacetonate, sublimed at the temperature applied and was sublimatrographically separated from uranyl acetylacetonate. Furthermore, sublimation method was applied to study the behavior of ^{239}U and ^{239}Np produced by the neutron irradiation of uranyl acetylacetonate. (auth)

Radioactive Waste Treatment

Refer also to abstracts 27425 and 27427.

26753 (BARC-691) CENTRAL GLASS AND CERAMIC RESEARCH INSTITUTE REPORT NO. 13 AND FINAL REPORT PART III ON FIXATION OF HIGH LEVEL ATOMIC WASTE IN GLASS FOR ULTIMATE DISPOSAL. Part A. Thermal Decomposition of Fission Product Nitrates and Their Reaction With Glass Batch Additives. Part B. Kinetics of Reaction of $CsNO_3$ and $RbNO_3$ With Silica and Metakaolin. Mukerji, J.; Kanyal, P. B. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 40p. Dep NTIS (U. S. Sales Only) $4.00.

Thermal decomposition of fission product nitrates constituting a Purex waste and their reaction with silica, alumina, and aluminosilicate ($Al_2O_3 \cdot 2SiO_2$) were studied. Oxides of nitrogen may be released from fission product nitrates in the temperature range (150 to 850°C) either due to their thermal decomposition or due to the reaction of alkali nitrates with silica or alumina of the glass batch additives. Fission product nitrates, $CsNO_3$ and $RbNO_3$ excepting, react very slowly with silica, the principal glass-forming additive for a silicate glass, at temperatures of 1000°C. Complete reaction of Gr. II–Gr. IV metal nitrates with silica may be achieved at temperatures of 1400°C, which is too high for a fission product immobilization process. The alkali nitrates react very rapidly with boric oxide, silica, alumina, and metakaolin ($Al_2O_3 \cdot 2SiO_2$) at subsolidus temperatures forming the alkali metaborate, alkali disilicate, alkali monoaluminate, and alkali alumino disilicate, respectively. A phenomenological description of the heating-up process for fission product nitrate with silicate glass batch additives is included. It is recommended that if a silicate matrix is selected for incorporation of fission product, the glass melting should be carried out until a homogeneous or nearly homogeneous product is obtained and should not be stopped at a stage where a sintered or semivitreous mass is the resultant product. The kinetics of reaction of $CsNO_3$ and $RbNO_3$ with silica and metakaolin could be best interpreted by a combination of concept of order of reaction and solid state reaction models. It is suggested that a packing of porous metakaolin ball, maintained at a temperature of 600°C, and placed above the glass melting pot, will serve as an excellent material for retention of any evaporated $CsNO_3$ and $RbNO_3$ by their direct and rapid conversion into the insoluble $Cs_2O/Rb_2O \cdot Al_2O_3 \cdot 2SiO_2$. (auth)

26754 METHOD OF SEPARATING AND RECOVERING CESIUM FROM A SOLUTION. Horioka, M. Japanese Patent 1973-5438. 17 Jun 1966. 3p.

Cesium is separated and recovered by ion exchange method using mordenite zeolite after removing hydrogen fluoride with silicon dioxide or silicates from the solution. This zeolite is small grain of porous or dense natural white rock, having a microstructure including clay substance such as halloysite substituted for glassy substances such as quartz and cristobalite. The crushed grain of this zeolite passed through 10 mesh screen is used as the ion exchanger, where it may be treated or untreated with acid or alkali at a desired temperature and may be washed or unwashed. Hydrogen fluoride was removed in the form of volatile SiF_4 and cesium ion was absorbed perfectly on the zeolite. Cesium was eluted from it with a solution of alkali metal salts or ammonium salts and then recovered as a solid cesium salt by evaporation of the eluted solution to dryness. In one example, 5 g of the zeolite between 32 and 60 mesh were packed in a column of 13 mmφ and 350 mm long. On the other hand, a composed solution similar to the waste liquid from the Zirflex method at 6.8 of space velocity was prepared. In order to eliminate the corrosion of zeolite, $NaSiO_3$ was added to the solution to purge HF off. Since the leakage of ^{137}Cs was 2 to 3% after the run, 97 to 98% ^{137}Cs having 1,273 cpm/cc separated and recovered. (JA)

26755 PLUTONIUM RECOVERY FROM ORGANIC MATERIALS. Deaton, R. L.; Silver, G. L. (to United States Atomic Energy Commission). US Patent 3,778,497. 11 Dec 1973. Filed date 28 Jul 1972. 6p.

A method is described for removing plutonium or the like from organic material wherein the organic material is leached with a solution containing a strong reducing agent such as titanium (III) (Ti^{+3}), chromium (II) (Cr^{+2}), vanadium (II) (V^{+2}) ions, or ferrous ethylenediaminetetraacetate (EDTA), the leaching yielding a plutonium-containing solution that is further processed to recover plutonium. The leach solution may also contain citrate or tartrate ion. (Official Gazette)

Radioisotope Production

Refer also to abstracts 26705, 27119, 27139, 27153, 27165, and 27462.

26756 (MLM-2118, pp 32-37) SEPARATION CHEMISTRY. 28 Feb 1974.

In Mound Laboratory activities for the Division of Physical Research: July–December 1973.

A facility to perform the initial processing of the Cotter protactinium/thorium concentrate was constructed and put into operation. Separation of ^{229}Th from aged ^{233}U and recovery and purification of ^{234}U from aged ^{238}Pu materials are reported. (LK)

26757 RECENT DEVELOPMENTS IN GENERATORS OF ^{99m}Tc. Boyd, R. E. (Australian Atomic Energy Commission Research Establishment, Sutherland). pp 3-26 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

The preparation of ^{99m}Tc from ^{99m}Mo is most commonly accomplished by the chromatographic generator. The performance characteristics of this type of generator are well known and several commercial variations of the chromatographic generator are available to the worker in nuclear medicine. There are many references in the literature describing the limitations, in both performance and purity, associated with these generators, and others in which the cost factor has been unattractive when compared with alternative radionuclide systems. For the central dispensary, national institution or commercial concern which intends to provide, routinely, separated ^{99m}Tc and its compounds for direct administration, the performance of the chromatographic generator is usually unacceptable, and alternative devices, such as a solvent extraction system, must be sought. Some of the more important parameters which influence the performance of the chromatographic generator are here defined together with a comparison of generators containing low specific activity $(n,\gamma)^{99}Mo$ or carrier-free $(n,f)^{99}Mo$. Improved and alternative methods of preparing ^{99m}Tc are described, suitable for use in the larger laboratory, such as a central dispensary. Of particular interest is the sublimation generator, developed in Australia, from which multicurie quantities of ^{99m}Tc are readily separated at very high concentration and radionuclidic purity. Finally, our initial experience with the operation of an improved solvent extraction process is presented. A comparison of the preparation, performance, and cost of the various alternative ^{99m}Tc generating devices is made to assist where changes in technology are contemplated. (auth)

26758 ^{99m}Tc-GENERATOR: PURITY AND PRODUCTION CONTROL METHODS. Constant, R.; Fallais, C.; Charlier, R.; Bievelez, P. (Institut National des Radioelements, Mol, Belgium). pp 27-38 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

The production control methods employed on ^{99}Mo-^{99m}Tc-generators are described and the results obtained reported. A number of simple and rapid tests are described for control of quality by the user. The effects of radiochemical or chemical impurities on the preparation of various compounds are described. A device is proposed for obtaining a ready-to-use pertechnetate solution by solvent extraction. (auth)

26759 DEVELOPMENT OF KITS FOR SHORT-LIVED GENERATOR-PRODUCED RADIOISOTOPES. Mani, R. S.; Narasimhan, D. V. S. (Bhabha Atomic Research Centre, Trombay, India). pp 135-150 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

The Isotope Division of the Bhabha Atomic Research Centre has undertaken a program to develop procedures for the preparation and control of several short-lived radioisotope-labelled products such as ^{99m}Tc-labelled sulfur colloid, serum albumin, DTPA complex and albumin microspheres and of ^{113m}In-labelled ferric hydroxide aggregates and DTPA and gelatine complexes. Methods suggested in the literature for the preparation of these have been critically examined. A solvent extraction generator has been developed for the preparation of pure ^{99m}Tc from low specific activity ^{99}Mo. Progress in improving the labelling techniques, the development of labelling kits for use in hospitals and of control kits to enable rapid quality control by the hospital staff are described. Kits for preparation and control of ^{99m}Tc sulfur colloid and DTPA complexes of ^{99m}Tc and ^{113m}In have been standardized. Published methods for evaluation of the radiochemical purity of technetium-albumin and ^{113m}In iron hydroxide aggregates have been found to be unsatisfactory. Gel filtration over Sephadex has been found to give a clear indication of the

presence of labelled impurities which are not segregated in paper chromatography or thin-layer chromatography. Work is also under way to develop kits for ^{125}I-labelled insulin, human growth hormone, Adrenal Corticotropic Hormone (ACTH) and Human Lutenizing Hormone (HLH), and the progress in this area also reported. (auth)

26760 ACCELERATOR PRODUCTION OF MEDICALLY USEFUL RADIONUCLIDES. Silvester, D. J. (Hammersmith Hospital, London). pp 197-222 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

In recent years the medical world has begun to employ, both in research, and in routine clinical applications, a widening range of radionuclides, many of which cannot be made in nuclear reactors. This has led to an increasing interest in accelerators as sources of useful radionuclides. Several medical centers have now installed purpose-built cyclotrons, and in many parts of the world other machines, originally built for other purposes, have been or are being modified to undertake radionuclide production. A review is presented of the current state of the technology that is being developed in order to use such accelerators to their best advantage. (auth)

26761 SEPARATED ISOTOPE TARGETS FOR RADIOISOTOPE PRODUCTION. Rupp, A. F. (Oak Ridge National Lab., TN). pp 223-237 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

For radioisotope production in both accelerators and nuclear reactors it is often desirable to use targets enriched or depleted in certain isotopes. The most obvious case is one in which the desired target atoms are in very low abundance and one cannot achieve the necessary specific activity with the reactor or accelerator fluxes available. This is particularly true when the product nuclide is short-lived and the activation cross-sections are low. In other cases, different isotopes of an element produce radionuclides that are unwanted contaminants of the primary radioelement being sought. An example that illustrates both of these points is the production of 4.7-day ^{47}Ca. The target isotope ^{46}Ca has only 0.003% abundance, and the activation cross-section is only 0.47 barn. The co-produced isotopic radiocontaminant is 165-day ^{45}Ca for which the target isotope (^{44}Ca) abundance 2.06% and the cross-section is 0.67 barn. The general principles for selecting cases suitable for enriched targets and many similar cases are cited, [e.g., ^{43}Ca(n,p)^{43}K, ^{68}Zn(p,2n)^{67}Ga, ^{98}Mo(n,γ)^{99}Mo, ^{152}Gd(n,γ)^{153}Gd]. Enriched radionuclide targets [e.g., ^{36}Cl(n,α)^{33}P] are also discussed and illustrative examples given. Recovery of valuable enriched isotope target material requires that special attention be given to target fabrication and processing. The techniques used are described and discussed with particular attention to economic factors. Radionuclides that are in the most general use today, for which target enrichment is applicable, are tabulated with pertinent data on enriched isotope availability and the improvement in production rates, specific activity, and purity that may be obtained by using enriched targets. (auth)

26762 RECENT ASPECTS OF CYCLOTRON PRODUCTION OF MEDICALLY USEFUL RADIONUCLIDES. Gelbard, A. S.; Hara, T.; Tilbury, R. S.; Laughlin, J. S. (Sloan-Kettering Cancer Center, New York). pp 239-247 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

A review is presented of recent work with the S.K.I. cyclotron on isotope production and preparation of medically useful radiopharmaceuticals for use in our research program. Methods of production of some 15 radioisotopes are briefly described and their production rates given. Some aspects of target design are discussed. The method of preparation of ammonia-^{13}N by deuteron irradiation of methane is described, and experimental results on the effect of radiation dose, and added gases (H_2,N_2,O_2) are presented. The use of $^{13}NH_3$ for the enzymatic synthesis of glutamine and glutamic acid is described. The production and chemical purification of ^{73}Se is described in the chemical forms of selenite and selenate. Germanium slices are irradiated with ^{3}He particles and ^{73}Se is produced in a yield of 2 - 3 mCi/μA at saturation. The preparation of H^{11}CN for labelling blood is described. (auth)

26763 COMPARATIVE STUDIES ON THE ADVANTAGE OF ^{4}He OR ^{3}He PARTICLES BOMBARDMENT FOR THE PRODUCTION OF ^{52}Fe AND ^{123}I FOR MEDICAL USE. Murakami, Y.; Akiha, F.; Ezawa, O. (Tokyo Metropolitan Univ.). pp 257-273 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and Labelled Compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

Practical production methods of supplying sufficient amounts of ^{52}Fe and ^{123}I for medical use were examined. The bombardment of ^{4}He or ^{3}He particles up to 45 MeV with the IPCR Cyclotron was carried out on the targets of chromium or antimony metals for the production of ^{52}Fe and ^{123}I respectively. The nuclides applied for medical use should be as pure as possible in the radionuclidic and radiochemical states. Therefore the measurement of excitation functions of all expected nuclear reactions induced under bombardment conditions was done, followed by the construction of thick target yield curves for these nuclides formed. The radiochemical separation methods were thoroughly studied by radioactive tracers, and the best methods were proposed for the purification of the two nuclides, together with separation methods for ^{52}Mn or ^{54}Mn, which are inevitably formed in considerable amounts. It was found that bombardment of ^{3}He particles up to 40 MeV on a chromium target is superior to ^{4}He bombardment in giving higher yields up to 50 μCi/μAh with a remarkably lower yield of ^{55}Fe. During this bombardment, a considerable amount of ^{52}Mn was simultaneously produced which is easily separated by the proposed method. For the production of ^{123}I, bombardment of ^{4}He particles up to about 25 MeV has an advantage in giving lower yields of ^{124}I, which is also an undesirable nuclide in medical application, compared with the bombardment ^{3}He particles. (auth)

26764 CYCLOTRON AND SHORT-LIVED HALOGEN ISOTOPES FOR RADIOPHARMACEUTICAL APPLICATIONS. Lambrecht, R. M.; Wolf, A. P. (Brookhaven National Lab., Upton, NY). pp 275-290 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

Iodine, fluorine, chlorine and bromine have radioisotopes with the desirable property of a short half-life and the ideal decay characteristics required for efficient detection on gamma and/or positron cameras. ^{123}I ($T_{\frac{1}{2}}$ = 13.3 h, γ = 159 keV (83%)) has not been previously available without an unacceptable ^{124}I contamination, even though ^{123}I is the ideal radioiodine for most diagnostic applications. Administration of high-purity ^{123}I to patients results in a radiation dose of $^1/_{100}$ of that received from the equivalent amount of the commonly used ^{131}I. In the past, ^{18}F ($T_{\frac{1}{2}}$ = 110 min, β^+) has generally been available only as fluoride in aqueous solution. We have developed new cyclotron methods for the production of ^{123}I and ^{18}F in good yield and high radiochemical purity. ^{123}I is routinely obtained at BNL by the ^{122}Te(α,3n)^{123}Xe $\rightarrow$ ^{123}I nuclear reactions with E_α = 46 - 35 MeV used to produce the 2.1-h half-life ^{123}Xe parent. The ^{123}Xe, which may be continuously removed from the isotopically enriched ^{122}Te target during the irradiation, is rigorously scrubbed to remove the ^{124}I impurity. After ~6.5 h the optimum yield and ≥99.8% radionuclidic purity of ^{123}I are obtained. The only radiohalogen impurity is ^{125}I, which neither interferes with scintigraphic imaging nor deposits an appreciable radiation dose in the patient. Alternate nuclear reactions that can be used to produce ^{123}Xe, and selected direct nuclear reactions to produce ^{123}I, are also evaluated. The ^{123}Xe(β^+,EC)^{123}I nuclear transformation was used to produce carrier-free iodinating reagents, such as ^{123}ICl, Na^{123}I, a new reactive ^{123}I species, and can also be used for excitation labelling. Carrier-free, anhydrous ^{18}F was produced by the ^{20}Ne(d,α)^{18}F (E_d = 16.5 - 0 MeV) and the ^{20}Ne (^{3}He,x)^{18}Ne $\xrightarrow[1.1\ sec]{\beta}$ ^{18}F (x = 2p3n, ^{3}He2n, αn) nuclear reactions at $E_{^3He}$ = 55 $\rightarrow$ 41 MeV. A specially prepared nickel irradiation vessel and flow system was designed to recover dynamically ^{18}F from the target. The fluorinating reagents that can be obtained are ^{18}F, X^{18}F (X = F, I, H or Cl), $CF_2^{18}FO^{18}F$, NO^{18}F, and ^{18}F$^-$. The ^{18}Ne (β^+)^{18}F nuclear transformation is a potential method for excitation labelling with ^{18}F. Isotope production rates, and experimental parameters such as target fabrication, repurification and recovery procedures, and examples of the preparation of the iodinating and fluorinating reagents used to obtain labelled radiopharmaceuticals, are discussed. The cyclotron production of other medically interesting halogen nuclides is summarized. (auth)

26765 ACCELERATOR PRODUCTION OF ^{18}F, ^{123}Xe(^{123}I), ^{211}At AND ^{38}S. Lindner, L.; Brinkman, G. A.; Suer, T.H.G.A.; Schimmel, A.; Veenboer, J. T.; Karten, F. H. S.; Visser, J.;

Leurs, C. J. (Inst. for Nuclear Physics Research, Amsterdam). pp 303-316 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

Methods are described for the production of four radionuclides of interest for biomedical applications. ^{18}F is produced in an internal dynamic "loop" target from $^{4}He^{2+}$ irradiations on circulating water. Yields are about 7 mCi $^{18}F/\mu Ah$. ^{123}I is formed indirectly from decay of ^{123}Xe. The latter is produced in an internal dynamic "loop/generator" target from proton bombardments on a circulating fluid containing iodine. Yields of >0.5 mCi $^{123}I/\mu Ah$ are envisaged. The production rates for both ^{18}F and ^{123}I compare favorably with those of others, but the methods we use to produce them have certain advantages, including inexpensive target materials and the possibility of production on a continuous basis under conditions of minimum exposure to radiation of the personnel. ^{211}At is produced from metallic bismuth bombarded with $^{4}He^{2+}$ beams. A simple and reliable method is used to collect the ^{211}At after distillation from the (molten) bismuth, with yields of about 0.5 mCi/μAh. Two different nuclear reactions are indicated to produce ^{38}S from argon targets, opening the way to possible applications of this isotope. (auth)

26766 COMPARATIVE INVESTIGATION OF METHODS USED TO PRODUCE ^{67}Ga WITH A CYCLOTRON. Helus, F.; Maier-Borst, W. (Inst. of Nuclear Medicine, Heidelberg). pp 317-324 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

Low yields of ^{67}Ga from the $^{65}Cu(^{4}He,2n)^{67}Ga$-reaction and a relative high yield of a ^{66}Ga contamination stimulated the investigation of reactions for the production of ^{67}Ga. The study was carried out with the cyclotron of the Max-Planck Institute in Heidelberg. The yields of ^{67}Ga and ^{66}Ga were studied in dependence on the energy of the bombarding particles for various reactions. The purity of the ^{67}Ga-preparations was measured with a Ge(Li) spectrometer. Chemical separation methods were developed to produce carrier-free ^{67}Ga. (auth)

26767 ^{135}Xe: ROUTINE PRODUCTION AND ADVANTAGES IN MEDICAL DIAGNOSTIC PROCEDURES. McLain, M. E. Jr. (Georgia Inst. of Tech., Atlanta). pp 223-230 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

The 250 keV γ ray energy and 97% intensity of ^{135}Xe make it potentially superior to ^{133}Xe (81 keV and 35%) for pulmonary function and regional blood flow studies. ^{135}Xe is not commercially available because of the high costs incurred in the separation of this fission product from irradiated uranium targets by the conventional dissolution methods. Developments at the Georgia Tech Research Reactor have demonstrated the feasibility of use of a special high surface area uranium target from which the fission product gases are readily released by diffusion. These developments have been applied to the design and operation of a prototype production loop installed in the reactor for routine production of ^{135}Xe and other short-lived fission-produced gases. ^{135}Xe patient dose rates have been calculated and compared with the ^{133}Xe dose rates used at present. (auth)

26768 DISCOVERY OF AN OLD RADON GENERATOR. Gillespie, P. J.; Alexander, J. L. Brit. J. Radiol.; 47: No. 554, 161-162(Feb 1974).

Brief note is made of "Lars Radium Emanator", discovered in a disused barn on a Northern Ireland farm. It was thought that the device was designed to produce a supply of radioactive water. Attempts to extract radon, by forcing coal gas into the receptacle at one end brought conclusions that radon was being generated, but that no radium salt was released during the experiment. Assuming the contents were drunk daily and the receptacle refilled with water after use, the daily intake of radon was calculated to be 2 μCi/150 ml of H_2O. The annual dose to the gastric lining under these conditions would be ~160 rem, 100 times the permissible ICRP dose. No radioactive contamination was detected in personnel who had handled the device, and wipe testing did not reveal surface contamination. (UK)

Reactor Fuel Reprocessing

Refer also to abstract 26615.

26769 (AAEC/E-275) REDUCTION OF CAPITAL COSTS IN REPROCESSING POWER REACTOR FUELS: A DESIGN STUDY. Costello, J. M.; Levins, D. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1973. 292p. Dep. NTIS (U. S. Sales Only) $16.75.

The design and cost structures of conventional types of commercial reprocessing plants are reviewed. Process functions offering the greater potential saving in capital cost are identified. Unorthodox approaches to philosophies of plant layout, maintenance procedures, and radiation shielding were formulated with the primary aim of reducing capital cost. Four conceptual designs were made of a large scale reprocessing plant based on existing shear leach solvent extraction technology, incorporating novel equipment types and unorthodox design philosophy. Preliminary capital cost estimates for the designs are in the range \$37 to 41 $\times 10^6$, indicating a 30 to 37% reduction in comparison with a conventional plant of identical capacity and scope. Additional costs exceeding \$30 $\times 10^6$ could be incurred for refinement to effluent treatment and storage systems envisaged for environmental protection for any type of reprocessing plant. (auth)

26770 (KFK-1373) INVESTIGATION OF THE DECOMPOSITION PRODUCTS IN THE SYSTEM 20 VOL. % TRIBUTYL PHOSPHATE–DODECANE–NITRIC ACID. II. Product Analysis. Becker, R.; Stieglitz, L. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Heisse Chemie). Nov 1973. 43p. (In German). Dep. NTIS (U. S. Sales Only) $5.25.

The nature of the diluent degradation products which are responsible for zirconium retention in the Purex process was investigated. By high vacuum molecular distillation of an irradiated solvent a concentrated residue with strong extracting power was produced. Further enrichment of the complexing agents was achieved by a selective extracting procedure. The acid compounds of this extract were converted to the methyl esters and analyzed via gas chromatography and mass spectrometry. More than twenty compounds were identified with a molecular weight between 238 and 364. Nearly all compounds have in common that they can be derived from acid phosphate esters which have besides an unchanged butyl group a second alkyl group with a carbon chain length between C_5 to C_{14}. (auth)

26771 (RT/CHI-(73)10) EXPERIENCES OF THE HOT REPROCESSING CAMPAIGN OF IRRADIATED MTR FUEL ELEMENTS WITH AN AMINE FLOWSHEET AT THE EUREX PLANT, SALUGGIA, ITALY. Cao, S.; Dworschak, H.; Hall, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 27 Nov 1973. 86p. Dep. NTIS (U. S. Sales Only) $7.50.

The results obtained during 1971 with the campaign for reprocessing highly enriched uranium, using tertiary aliphatic amines (TCA) diluted in Solvesso 100 as extractant, are reported. Flowsheet performances for U recovery, U/Pu (and Np) separation, and fission product decontamination are emphasized. A special final U purification was set up with an aliphatic hydroxamic acid highly soluble in organic diluent (HX). Pu(IV) and Np(IV) were selectively extracted to meet the transuranium alpha activity specifications for the final U product. The accountability system and procedures are described as adopted for the Eurex plant. A detailed analysis is made of the inventory at the end of this reprocessing campaign. (auth)

26772 (RT/CHI-(73)14) ANALYTICAL LABORATORIES OF THE EUREX REPROCESSING PLANT AND THE FIRST MTR CAMPAIGN. Pozzi, F.; Orsello, S.; Pagliai, V.; Todini, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 18 Dec 1973. 39p. Dep. NTIS (U. S. Sales Only) $5.00.

The equipment and the instrumentation of the Analytical Laboratories of the Eurex Reprocessing Plant are described. The most important analytical methods used during the first MTR fuel reprocessing campaign (1970-1971) are also indicated, together with the statistical data concerning the analytical load and the precision and accuracy of the analytical methods. (auth)

26773 RECOVERY OF PROTACTINIUM FROM MOLTEN FLUORIDE NUCLEAR FUEL COMPOSITIONS. Baes, C. F. Jr.; Bamberger, C.; Ross, R. G. (to United States Atomic Energy Commission). US Patent 3,781,403. 25 Dec 1973. Filed date 30 Nov 1971. 6p.

A method is provided for separating protactinium from a molten fluoride salt composition consisting essentially of at least one alkali and alkaline earth metal fluoride and at least one soluble fluoride of uranium or thorium which comprises oxidizing the protactinium in said composition to the +5 oxidation state and contacting said composition with an oxide selected from the group consisting of an alkali metal oxide, an alkaline earth oxide, thorium oxide, and uranium oxide, and thereafter isolating the resultant insoluble protactinium oxide product from said composition. (Official Gazette)

ENGINEERING

Energy Conversion

Refer also to abstracts 28439 and 28787.

26774 (AD-762934) EXPLOSIVE MAGNETOHYDRODYNAMIC PROGRAM. Technical Report, 2 January–1 October 1972. Bangerter, C. D.; West, L. R.; Brogan, T. R.; Sheldon, D. B.; Stekly, Z. J. J. (Hercules, Inc., Magna, Utah (USA). Bacchus Works). May 1973. Contract F33615-72-C-1394. 255p. (AFAPL-TR-73-16). NTIS $6.75.

An analytic study is presented with the addition of design and experimental data required to augment the study. The analysis presented is conclusive in its finding that the X-MHD is a highly versatile prime power source which can be operated without benefit of vacuum equipment in residual ambient pressure gases of various composition and at high repetition rate with various loads. At high repetition rate, the spent explosion products of a previous round are an ideal residual or purge gas. Energy conversion efficiency in excess of 10% should be attainable with optimized residual gases at ambient pressure, and from 5 to 10% with spent explosion product residual gases at field levels currently achievable with superconducting magnets. (auth)

26775 (COM-73-11692-3-GA) THERMIONICS: A BIBLIOGRAPHY WITH ABSTRACTS. Report for 1970–September 1973. Lehmann, E. J. (National Technical Information Service, Springfield, Va. (USA)). Oct 1973. 122p. (NTIS-WIN-73-51). NTIS $20.00.

The NTISearch bibliography contains 117 selected abstracts of research reports retrieved using the NTIS on-line search system—NTISearch. The abstracts cover over three years of government research on thermionics. The topics include power generation, power plant design, converter design, and basic research on thermionic materials. (auth)

26776 (FRNC-TH-460) STUDY OF RARE GAS PLASMAS SEEDED WITH AN ALKALINE SUBSTANCE. Darrigo, R. (Paris-5 Univ., 75 (France)). 1973. 141p. (In French). Dep. NTIS (U. S. Sales Only) $10.25.

Thesis.

The transfer properties of a mixture of inert gases and potassium suitable for use in magnetohydrodynamic generators were determined. Hypotheses were put forward in order to define the interaction potential between two atoms of potassium. The transfer properties were subsequently evaluated. New experimental results have since been obtained. Special attention is given to those of Ivanovskii et al. which give the self-diffusion coefficient for potassium and the diffusion coefficient for helium–potassium. The results obtained differ by no more than 1% from those presented. The hypotheses put forward are thus valid and it is assumed that the transfer properties obtained for the complex mixture are realistic. Nevertheless, the properties connected with thermodiffusion necessitate supplementary verification. The interpretation of the preliminary experimental results in terms of the strengths of the Heierman oscillator led to the identification of a disequilibrium between the temperatures of the heavy and light species. In addition, the transfer properties were calculated for different values of the disequilibrium coefficient. New values are suggested for the oscillator strengths of the principal and diffuse series of potassium from experimental results obtained using two different installations, i.e., a helium–argon–potassium mixture and a flame seeded with potassium carbonate. In order to study recombination, a boundary layer was produced by circulating the plasma near to an externally cooled wall. The determination of the recombination coefficient in the central core yields results similar to those of Bates. This is not true, however, for the boundary layer. The excessively large values obtained in this case suggest the existence of a disequilibrium. (FR)

26777 (LA-5489) MASS SPECTROMETRIC DETERMINATION OF $^{18}O/^{16}O$ RATIOS TO LOCATE THE SOURCE OF OXYGEN IN SNAP FUEL CAPSULE COMPONENTS. Smith, M. E.; Waterbury, G. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 3p. Dep. NTIS $4.00.

The successful application of a mass spectrometric method to determine the source of oxygen diffusion into the container material of a radioisotopic fuel capsule is described. The source was chiefly the oxide fuel ($^{238}PuO_2$) and not the atmosphere. This could be accomplished by determining the $^{18}O/^{16}O$ ratio in the tantalum alloy material, because the ^{18}O content of the fuel had been reduced to minimize α-n reactions. The $^{18}O/^{16}O$ ratio was $\sim 5.5 \times 10^{-4}$ for fuel as compared with 2×10^{-3} for air. The radiochemical method, based on an α-n reaction, could not be applied because of the very low α-particle flux in the liner material. (auth)

26778 (MND-2994-2) RADIOISOTOPE GENERATOR FOR USE IN THE VOYAGER SPACECRAFT (ORBITER). (Martin Marietta Corp., Baltimore, Md. (USA)). Jun 1963. 25p. Dep. NTIS $3.25.

Declassified 27 Nov 1973.

Design and operating parameters for three radioisotope-powered thermoelectric generators for use on the Voyager spacecraft are presented. The generators are fueled with ^{244}Cm and produce 285 W(e) each. (TFD)

26779 (MND-3169-17-B) SNAP 19-C2 INSTALLATION AND OPERATING PROCEDURES. (Martin Marietta Corp., Baltimore, Md. (USA)). 9 Jul 1966. Contract AT(30-1)-3169. 37p. Dep. NTIS $4.00.

Declassified 28 Nov 1973.

Procedures to be followed in transporting, installing, and operating the SNAP 19C-2 thermoelectric generator are presented. (TFD)

26780 (MND-3169-18-C) ADDENDUM TO SNAP 19-C2 SITE HAZARDS ANALYSIS AND SAFETY REPORT. (Martin Marietta Corp., Baltimore, Md. (USA)). Jul 1966. Contract AT(30-1)-3169. 55p. Dep. NTIS $4.75.

Declassified 27 Nov 1973.

The probabilistic approach to safety assessment of SNAP 19C-2 is applied in greater detail than in the initial report, MND-3169-18-B. (TFD)

26781 (NAA-SR-12017) LARGE RADIOISOTOPE COMPACT CONVERTER POWER SYSTEM STUDY FINAL REPORT TO THE U. S. ATOMIC ENERGY COMMISSION. (Atomics International Div., Canoga Park, Calif. (USA)). 30 Jun 1966. Contract AT(11-1)-Gen-8. 271p. Dep. NTIS $15.75.

Declassified 6 Sep 1973.

Design and operating parameters for ^{210}Po- and ^{238}Pu-fueled thermoelectric generators for use in the Apollo Program are presented. (TFD)

26782 HIGH TEMPERATURES IN MAGNETOHYDRODYNAMIC ENERGY CONVERSION. Ricateau, P. (CEA, Paris); Yerouchalmi, D. pp 189-219 of High Temperatures and Their Uses in Physics and Chemistry. Vol. 1. Chaudron, G. (Ed.). Paris; Masson (1973). (In French).

Some general aspects of magnetohydrodynamic conversion in gases are presented, i.e., conversion in combustion gases and conversion by gases in closed cycles. In open cycle conversion, fossil energy sources are used, the combustion gas acting as the conducting fluid. In closed cycle conversion, a gas coolant, selected because of its heat conducting properties, executes a closed heat cycle exchanging heat with hot and cold sources; the hot source may be of fossil or nuclear origin. The materials and refractory structures used in MHD energy conversion (open and closed cycles) are then studied. (FR)

26783 EFFECT OF FINITE CHEMICAL REACTION RATES ON HEAT TRANSFER TO THE WALLS OF COMBUSTION-DRIVEN SUPERSONIC MHD GENERATOR CHANNELS. Daily, J. W. (Stanford Univ., CA); Raeder, J.; Zankl, G. AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 12: No. 3, 403-404(Mar 1974).

The effect of finite-rate homogeneous chemical reactions on the heat transfer rates to the walls of combustion-driven supersonic MHD generators was investigated. Experiments were performed on a 200 kW(e) combustion generator. The density of the heat flux to the wall was measured at various axial positions along both a circular cross section Hall-type channel and a diagonal wall channel with a rectangular cross section. From the results it was concluded that a substantial decrease in heat transfer rate to the walls of a combustion-driven supersonic MHD power generator was observed which appears to occur because of chemical nonequilibrium in the developing wall boundary layers. (LCL)

26784 CONTRACTION OF THE DISCHARGE IN A THERMIONIC CONVERTER. Martsinovskii, A. M.; Sonin, E. B. (Physical-Technical Inst., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: 539-541(Oct 1973).

Translated from Zh. Tekh. Fiz.; 43: 855-860(Apr 1973).

A simplified analytic model of an arc is used to show that the discharge in a thermionic converter must contract into a filament

at the transition from the arc mode to the diffusion mode, in agreement with experiment. The contraction occurs at a low neutralization parameter, at which the voltage-current characteristics calculated for a transversely homogeneous plasma display an unstable negative-resistance region. (auth) (IAA)

Facilities and Equipment

Refer also to abstracts 26879 and 28948.

26785 (JUL-1020-RG) MULTIPLE MEASUREMENT TECHNIQUES WITH PROCESS-COMPUTER CONTROL AND DATA GATHERING AT TWO TEST EQUIPMENTS FOR DETERMINING HYDROGEN PERMEATION THROUGH HEAT-EXCHANGER MATERIALS. Diehl, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Nov 1973. 110p. (In German). Dep. NTIS (U. S. Sales Only) $8.50.

A method of multiple measurement techniques including data gathering and data handling by an analog-to-digital converter and a process-computer PDP 15/20 in minimal configuration is described. As an example, the realized asynchronous operation of two test equipments for determining the hydrogen permeation through heat exchanger materials is reported. The determination of the permeated hydrogen (vpm-concentrations) is done with one gas chromatograph for each test equipment consisting of ten test cells. The solutions due to hardware and software efforts are described. (auth)

26786 (LA-5211-MS) SUBTERRENE ELECTRICAL HEATER DESIGN AND MORPHOLOGY. Armstrong, P. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 29p. Dep. NTIS $4.00.

The design, construction, and testing of a variety of electrical heaters for small-diameter Subterrene penetrators has been pursued. The incompatibility of refractory materials at the required operating temperatures of ~2000°K and the large heat-flux requirements posed the most difficult design problems. Heat fluxes of up to 2.0 MW/m^2 were obtained from pyrolytic-graphite radiant heat-transfer elements and were as high as 2.5 MW/m^2 when this type of heater was combined with a lithium heat-pipe assembly. Penetrators using radiant heaters produced both vertical and horizontal holes of 50 mm dia up to lengths of 25 m, whereas holes of up to 64 mm dia and 0.5 m long were produced in basalt and other rock samples in the laboratory. (auth)

26787 (LA-5508-MS) FAILURE OF COOLING TOWER LOB-CT-1. Midkiff, W. S. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1974. Contract W-7405-eng-36. 9p. Dep. NTIS $4.00.

Following the loss of cooling tower LOB-CT-1, an investigation was conducted to determine the cause and to develop precautions to prevent future cooling tower losses. This cooling tower, located in the office-building basement of the Clinton P. Anderson Los Alamos Meson Physics Facility (LAMPF), was shut down on October 29, 1973. Excessive use of chelate chemical was judged to be the major factor involved in the high corrosion rates observed. A number of precautions are listed which should prevent further "surprise" corrosion problems. The precautions include precalculation of chemical additions, visual inspection, corrosion coupons, corrosion meters, and chemical analyses of operating conditions. (auth)

26788 (LA-5517-MS) CONCEPTUAL DESIGN OF A CORING SUBTERRENE GEOPROSPECTOR. Neudecker, J. W. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 14p. Dep. NTIS $4.00.

A rock-melting Subterrene system is described that can obtain a continuous core along the projected route of a tunnel. System specifications, individual component functions, preliminary design concepts, and design alternatives are included; and subcomponents that can be assembled from commercially available hardware are indicated. The device requires 150 kW of electric power to melt an accurate 300-mm (1-ft)-dia glass-lined hole and removes a 200-mm (8-in.)-dia glass-cased core at an advance rate of 0.4 mm/s (5 ft/h). The accurate hole diameter and stable hole lining allow the use of a packer-thruster located at the heated hole-melting and hole-forming penetrator assembly. An orientation sensor and a guidance unit can also be located in this assembly. A hollow, flexible stem trailing behind the assembly contains the electric-power, coolant, and instrumentation lines, and provides a passage for debris removal. Core sections are removed through the flexible stem intermittently with wire-line core-retrieval hardware. This Subterrene system, named Geoprospector, is essentially a self-propelled and surface-guided minitunneler. It is a logical major development step in the Subterrene program, directed toward a larger-diameter tunneling machine. Other practical Geoprospector applications are the forming of holes under obstacles such as rivers, highways, buildings, or other structures to accommodate utility lines or cables; the implantation of urban utilities; and the installation of underground pipelines or power-transmission lines without ditching. (auth)

26789 (RT/ING-(73)19) DESCRIPTION AND INSTRUCTION FOR USE OF THE SAFE-SHELL. B Finite Element Program in the IBM/360 Version. Cesari, F.; Labanti, L.; Palmieri, I. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 18 Dec 1973. 55p. (In Italian). Dep. NTIS (U.S. Sales Only) $5.75.

A new version of the finite element program SAFE-SHELL, for the stress-analysis of the axial-symmetrix shell structures, implemented on the IBM 360/75 system is presented. (auth)

26790 (SLA-74-5229) MATHEMATICAL MODEL FOR PREDICTING RADIATION SURFACE LOSSES FROM A LASER-HEATED FOIL. Schimmel, W. P. Jr.; Donaldson, A. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 5p. (CONF-740504-3). Dep. NTIS $4.00.

From twentieth international instrumentation symposium; Albuquerque, New Mexico, USA (21 May 1974).

The method of Laplace transforms is used to solve for the temperature profile in a two-layer composite, composed of a thin foil and a semi-infinite body. Heat generation takes place in the foil at a rate which approximates, qualitatively, the deposition of energy from a laser pulse. Results indicate that the process can be considered adiabatic for small times with respect to deposition time, but losses must be considered near the end of the energy pulse. (auth)

26791 INDUSTRIAL AND MILITARY APPLICATIONS OF NUCLEAR ENERGY. Bonnet, P. Paris; Centre d'Edition et de Documentation de l'Ecole Nationale Superieure de Techniques Advancees (1973). 108p. (In French).

The present course is intended to give an overall view of the industrial and military applications of nuclear fission techniques. The physical presentation of nuclear phenomena such as detonation and the production of chain reactions in which neutrons and fissile nuclei participate is given in such a way as to avoid mathematical developments. Nevertheless, a brief outline is given of calculation methods applicable to nuclear reactor cores. The principal developments in the energy production industry linked to the appearance of industrial nuclear plants are exposed together with military science applications: armaments; nuclear devices; nuclear propelled ships and submarines. (auth)

26792 SAMPLER OF AIR-BORNE PARTICLES. Andersen, A. A. (to 2000 Inc.). US Patent 3,795,135. 5 Mar 1974. Filed date 7 Nov 1972. 4p.

An apparatus to extract minute particles from a gas and deposit them on surfaces for inspection and analysis is described. It consists of a plurality of stacked perforated discs held firmly in position by a retainer and spaced apart by a ring, and an air inlet and outlet, vacuum pump attachment for attaching a vacuum pump to draw air or other gases through the device, with the perforations in the discs in alternating positions in relation to the perforations next below and above. The apparatus of this invention is so constructed as to be easily assembled and disassembled and inexpensive to manufacture. (Official Gazette)

Heat Transfer and Fluid Flow

Refer also to abstracts 26783, 26868–26874, 28752, 28756, and 28932.

26793 (AERE-R-7593) RS 96: THE EVAPORATION OF BINARY MIXTURES IN FORCED CONVECTION. Part II. Theoretical Studies. Shock, R. A. W. (UKAEA Research Group, Harwell, Atomic Energy Research Establishment). Oct 1973. 132p. Dep. NTIS (U. S. Sales Only) $9.75.

A nucleate boiling correlation is incorporated into a modification of the Chen correlation, which is satisfactory for the convective boiling of pure fluids. A computer program, written to predict the axial variation of wall temperature and concentration in convective boiling in a vertical electrically heated tube is described. Computer routines written to predict phase equilibrium and physical properties of mixtures are given. The mass and heat transfer in climbing film flow are examined analytically. It is shown that the resistance to mass transfer in the liquid film is negligible and that the vapor phase resistance can also often be neglected. The process of heat transfer through the film is shown not to be influenced by the mass transfer occurring within it. (auth)

26794 (INIS-mf-1026, pp 9-16, Sect. 4.3) SOME EXPERIMENTAL RESULTS FOR HEAT AND MOMENTUM TRANSFER TO

A LIQUID BOILING IN UPWARDS FLOW IN A VERTICAL ANNULUS. Dolan, D. S. (Bechtel Pacific Corp. Ltd., Melbourne); Tait, R. W. F. 1973.

The apparatus used to measure local heat transfer coefficients and pressure gradients for upwards flow of pure liquids boiling in a concentric 1'' × 1.5'' annulus, and the experimental results obtained, are described. Two outer test sections were used, one was a Pyrex glass tube to permit observation of the two-phase flow regimes, the other was an electrically heated copper tube. Techniques were developed for embedding thermocouples in the electrically heated inner and outer test sections over their entire length, thus enabling local heat transfer measurements to be made. Independently controlled flows of vapor and saturated liquid were fed to the bottom of the annular gap between the test sections. The effects of liquid and vapor flow rate, heat flux, and an equivalent heat flux applied to the outer surface, on the heat transfer coefficient were studied for water and ethanol. The investigation was concentrated on the forced convection or liquid film flow region in which heat is transferred across the liquid film by conduction and eddy convection. Correlations of the local heat transfer coefficient in the forced convection regime showed that there was a significant difference in the effect of vapor flow rate for water and ethanol, the heat transfer coefficient being proportional to the vapor flow rate to the 0.82 power for water and to the 0.50 power for ethanol. The effect of liquid flow rate for water and ethanol was similar. The two-phase flow pressure gradients were measured using liquid purged monometers, with small bore pressure tappings in the outer surface of the annulus. (INIS)

26795 (INIS-mf-1026, pp 17-24, Sect. 4.3) EFFECTS OF SPACERS ON BURNOUT IN AN ANNULUS WITH A UNIFORMLY HEATED CENTRAL ROD COOLED BY FREON-12. Ilic, V.; Lawther, K. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1973.

The effect of spacer elements on flow boiling burnout conditions in an annulus was investigated with a stainless steel test section having a 14.4 mm dia heater rod, 2743 mm long, in a 22.1 mm ID tube, and using Freon-12 at a pressure of 1.035 MPa. The spacer elements were Tufnol cylinders of 3.8 mm diameter, 12.7 mm long, and were used in sets of three, equally spaced around the heater rod. Three spacing arrangements were used, i.e., an essentially bare heater, sets of spacer elements at 304.8 mm pitch, and sets of spacer elements at 152.4 mm pitch. Results show that, depending on flow conditions (mass velocity and inlet temperature) and spacer arrangements, the spacers can have significant effects on burnout power. For some conditions the presence of spacers can cause a substantial increase in burnout power (an increase of approx. 80% was obtained); for other conditions the effect can be negligible, or even some reduction in burnout power can result. (INIS)

26796 (INIS-mf-1026, pp 41-49) MOMENTUM AND INTERFACIAL FRICTION FORCES IN FORCED CONVECTION CONDENSATION. Pittas, A. C. (Tasmania Univ., Sandy Bay (Australia); McKenzie, R. T. B. 1973.

Filmwise condensation of pure saturated vapors in tubes has been analyzed on the assumption of laminar annular condensate flow, by the application of the continuity, momentum, and energy equations averaged over the cross section. The resulting governing differential equations were solved numerically. The effect of the momentum and interfacial friction forces was investigated from a study of three versions of the physical model in the complete condensation of water, ammonia and refrigerant-12 vapors in vertical down flow in tubes. For an upper limit of vapor entry Reynolds numbers of 50,000 it was shown that gravity is the dominant flow force, particularly in the case of refrigerants with high vapor to liquid density ratios compared to water. Momentum forces do not appreciably affect the thermal characteristics of the process and an attempt to include momentum effects in semi-empirical correlations is considered unjustifiable. Interfacial shear has a small overall effect on the rate of condensation for the range of Prandtl numbers $1 < Pr < 10$. These conclusions are in agreement with observation of other researchers. The agreement with experiment was satisfactory. (INIS)

26797 (PWAC-368) DESIGN, FABRICATION, AND TEST OF A 1500F NaK-NaK HEAT EXCHANGER, HE-14S. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 15 Mar 1963. Contract AT(30-1)-2789. 62p. Dep. NTIS $6.25.

Declassified 20 Sep 1973.

The complete history of a high-temperature stainless steel heat exchanger design, fabrication and test effort authorized as a part of Atomic Energy Commission Contract AT(30-1)-2789 is presented. The heat exchanger designated as HE-14S is a completely welded, tube and shell, unbaffled unit fabricated from Type 316 stainless steel. It was operated using NaK (56 percent Na) on both tube and shell sides, with countercurrent flow, at liquid metal temperatures to 1500°F, flow rates to 400 gpm, and pressures to 62 psig, for a total time of 1,388 h. The total accumulated test time includes 175 h of heat-up and purification, 8 h of performance testing, and 1205 h of endurance testing. The heat exchanger was found to be in excellent condition upon termination of the test. Test termination was caused by failure of a tube in the direct-fired, liquid metal heater. (auth)

26798 BOILING CRISIS ON POROUS-COATINGS ON SURFACES. Nikolaev, G. P.; Tokalov, Yu. K. (Ural Polytechnic Inst., Sverdlovsk, USSR). Inzh.-Fiz. Zh.; 26: No. 1, 5-9(Jan 1974). (In Russian).

Experimental values on nucleate and film boiling of carbon dioxide on polished and porous cylindrical surfaces under conditions of saturation at reduced pressures $p/p_K = 0.93$ and 0.97 are discussed. A considerable increase of the maximal, minimal specific heat fluxes and maximal heat transfer coefficient was observed on a horizontal tube with thin porous coating. (auth)

26799 BOILING HEAT TRANSFER ON A NON-WETTED SURFACE. Toshiyuki, T. (Mitsubishi Heavy Industries, Ltd., Nagasaki); Hasegawa, S.; Echigo, R. Heat Transfer-Jap. Res.; 2: No. 4, 1-17(1973).

A saturated pool boiling experiment was conducted on a non-wetted surface and the boiling mechanism was explained by using a high speed camera. The results are as follows: the bubbles are bell-shaped and the bubble cycle consists of small bubble formation, small bubble coalescence, coalescent bubble growth and coalescent bubble departure; the coalescent bubble absorbs the small bubbles produced around it in the surroundings and grows, this growing period occupies the major part of the bubble cycle; and it is considered that the boiling heat transfer mechanism on a non-wetted surface is mostly due to latent heat transfer and convective heat transfer on the restricted region around the coalescent bubble. (auth)

Materials Testing

Refer also to abstracts 26937, 26957, 27253, 27292, 27388, and 28656.

26800 (BNWL-461) EVALUATION OF EDGE MOUNTED EDDY CURRENT PROBE COILS FOR DETECTION OF TRANSVERSE CRACKS IN COOLANT CHANNELS. Brown, R. L. Jr. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1967. 43p. Dep. NTIS $4.25.

Declassified 28 Aug 1973.

Several experiments were conducted to evaluate the relative crack detection effectiveness of an eddy current probe coil placed coaxially with a coolant channel and a similar coil placed on edge. It was found that the coaxial coil detected longitudinal defects most effectively, while the coil on edge detected transverse defects most effectively. It was also found that two coils mounted on edge and positioned 90° apart detected both longitudinal and transverse defects located anywhere on the circumference. (auth)

26801 (CEA-CONF-2519) INSPECTION OF STEEL PRESSURE VESSELS BY ACOUSTIC EMISSION. Chretien, N.; Bernard, P.; Barrachin, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France)). 1973. 44p. (CONF-731003-4). Dep. NTIS (U.S. Sales Only) $4.25.

From 2nd international congress for pressure vessel and piping technology; San Antonio, Texas, USA (1 Oct 1973).

The inspection of steel pressure vessels by acoustic emission is discussed in terms of: the importance of verifying the integrity of pressure vessels; equipment and methods for acoustic emission detection and the processing of data obtained as acoustic emission signals; the relation between fracture mechanisms and acoustic emission in steels; rupture mechanisms in test pressure vessels; hydraulic tests on industrial pressure vessels to evaluate the reliability of acoustic emission testing for detecting defects before leaks or ruptures occur; and current laboratory research on acoustic emission testing. It is concluded that the inspection of steel pressure vessels by detection of acoustic emission presents attractive features. First, it is a global control method and it is easy to apply to the pressurized equipment to be monitored. Secondly, the method ensures, if not continuous monitoring in the present status of its development, at least an efficient monitoring easy to adapt to normal operating conditions of the plant (pressure rises after shutdown, normal pressure transients, regulatory tests). Lastly, it is a selective method since it deals only with defects that are evolving, and consequently hazardous. (LCL)

26802 (INIS-mf-1109) GAMMASCOPY OF A DEBUTANIZATION TOWER. Moreira, R. M.; dos Santos, J. S. (Instituto de

Pesquisas Radioativas, Belo Horizonte (Brazil)). Sep 1972. 5p. (In Portuguese). INIS.

The gammascopy was done with the purpose to detect a suspected anomaly on the upper part (last 3.50m) of the T.5006 Debutanization Tower of the Refinaria Duque de Caxias (REDUC) in Rio de Janeiro State, Brazil. For the positioning of the ^{60}Co radiation source and the scintillation detector (SRAT SPP3 with a 1.0'' × 1.5'' NaI(Tl) crystal) a system based on the principle of communicating duets was used. (INIS)

26803 (SLA-74-5054) NDT AND INTERACTIVE DATA DISPLAY. Stiefeld, B. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 9p. (CONF-740504-1). Dep. NTIS $4.00.

From 20th international instrumentation symposium; Albuquerque, New Mexico, USA (21 May 1974).

Many NDT methods have traditionally been involved in the detection of localized defects such as cracks, voids, and inclusions. However, there has been an increasing demand for NDT methods that characterize material properties over surface areas or within the volume of a test subject. Infrared, eddy current, and ultrasonic scanning are some of the NDT methods that can be used to acquire large amounts of data. A small minicomputer-based system acting interactively to control experiments and apply graphic display techniques to the acquired data is described. IR and ultrasonic experiments are used as the example to demonstrate data conversion to engineering units and the use of contour data plotting and other interactive displays on a near real time basis. (A 16mm film is used during the presentation to stress the interactive procedure.) (auth)

26804 QUANTITATIVE EVALUATION OF RADIOAUTOGRAMS BY ELECTRONIC MEANS. Baumbach, H.; Hartmann, K.; Freyer, K.; Renker, K. (Zentral Institut fuer Isotopen- und Strahlenforschung, Leipzig). Isotopenpraxis; 9: No. 11/12, 413-420(1973). (In German).

In autoradiographic studies the quantitative evaluation of the autoradiograms obtained is an essential factor. Some fundamental aspects of this evaluation are discussed and various possibilities for two-dimensional evaluation with electronic methods are presented. In addition to the description of the design and construction of the Densitron I developed for electronic evaluation, its use for autoradiographic studies is illustrated with typical autoradiograms. Since the device is suitable not only for autoradiographic evaluation, other possible applications are briefly discussed. (tr-auth)

26805 LOCALIZATION OF BORATED CONSTITUENTS IN STEELS USING NEUTRON IRRADIATION AND (n,α) AUTORADIOGRAPHY AND SOLID TRACK DETECTORS. Boutaine, J. L.; Lemonnier, A. (CEN de Saclay, Gif-sur-Yvette, France). Mem. Sci. Rev. Met.; 70: No. 10, 747-752(Oct 1973). (In French).

The principles of the method are described together with the preparation of samples, the detector used (cellulose nitrate), the irradiation and development conditions, and the image reader. The following two metallurgical applications are described: determination of boron in a stainless steel, 12R72HV, and in a soft laminated steel. (FR)

26806 PROPERTIES OF SEAMLESS STEEL PIPES AND NONDESTRUCTIVE TESTING. Hamada, H. (Kobe Steel, Ltd., Japan). FAPIG (Tokyo); No. 69, 32-39(May 1973). (In Japanese).

Flaw detection in seamless steel pipes used in fossil and nuclear power plants and petrochemical plants is reviewed. The methods discussed include eddy current, magnetic, ultrasonic, fluorescent substance penetration, and dye penetration. (TFD)

26807 PRINCIPLE, SIGNIFICANCE, AND POSSIBILITIES OF TESTING BY RADIOGRAPHY. Kesl, J. (SKODA, Plzen, Czech.). Jemna Mech. Opt.; 18: 243-245(Sep 1973). (In Czech).

Description of the general principle of materials testing by radiography, and evaluation of the possibilities of various radiographic methods (x-ray, radioisotope, and betatron) are given. A classification of materials to be tested by radiography is presented, as well as basic data concerning the photographic technique and the determination of radiogram image quality. (IAA)

26808 STANDARD RECOMMENDED PRACTICE FOR EXAMINATION OF FUEL ELEMENT CLADDING INCLUDING THE DETERMINATION OF THE MECHANICAL PROPERTIES. Philadelphia; American Society for Testing and Materials (1972). 15p. (ASTM-E-453-72).

This recommended practice covers the procedures for post-irradiation examination of nuclear fuel elements, selection of material and tests for radiation studies, determination of radiation conditions, conduction of tests for mechanical properties of cladding, and the reporting data. The purpose of this recommended practice is to provide detailed guidelines for the post-irradiation examination of fuel cladding and to achieve better correlation and interpretation of the data in the field of radiation effects. This recommended practice may be applied to metallic cladding from all types of fuel elements and the tests for determining mechanical properties of the fuel element cladding described in this practice could be used in planning radiation effect tests for evaluation of materials for cladding and other components in nuclear reactors. (auth)

Nuclear Explosions

Refer also to abstracts 26830, 26925, and 26929.

26809 (AD-768617-3-GA) EXTENDED ARRAY EVALUATION PROGRAM. Special Report No. 9. Continued Evaluation of the Norwegian Short-Period Array. Ringdal, F.; Whitelaw, R. L. (Texas Instruments, Inc., Dallas (USA)). 10 Aug 1973. Contract F33657-72-C-0725. 108p. NTIS $4.25.

The continued evaluation of the Norwegian short-period Seismic Array (NORSAR), which was conducted by Texas Instruments Incorporated at the Seismic Data Analysis Center over the period 1 April 1972 to 31 March 1973 is described. The major areas of study presented in this report are: signal analysis on a regional basis; signal amplitude response patterns across the array; array processing performance; NORSAR seismic event detection capability; and behavior of short-period seismic discriminants. The total data base for this study comprises 344 events. (GRA)

26810 (AD-768784-1-GA) FEASIBILITY OF PARAMETER SENSITIVITY ANALYSIS OF THE DIFFUSION EQUATION AS APPLIED TO PROBLEMS IN NUCLEAR THERMAL VULNERABILITY. Grotte, J. H. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Sep 1973. 20p. NTIS $2.75.

Calculational determination of the nuclear thermal vulnerability of Army equipment requires a knowledge of the specific heat and thermal conductivity of the constituent materials. Since the temperature dependence of these properties for most materials is not known, constant values are often used in heat transfer calculations. A study that was conducted to formulate general rules for predicting the sensitivity of the calculated temperatures to changes in these parameters is described. It was concluded that the problem of geometry is the governing parameter in heat transfer calculations. Therefore, it is recommended that either of two approaches be used: (1) a worst case analysis or (2) the use of several values of specific heat and thermal conductivity to generate an envelope in which the actual value would be. (auth)

26811 (AD-768987-0-GA) SIMULTANEOUS THREE-COMPONENT BROAD-BAND EARTH NOISE STRUCTURE AT VERY-LONG-PERIOD EXPERIMENT STATIONS. Special Report No. 10. Extended-Array Evaluation Program. Alsup, S. A.; Becker, E. S. (Texas Instruments, Inc., Dallas (USA)). 29 Jun 1973. Contract F33657-72-C-0725. 54p. NTIS $4.75.

A series of one-hour seismic noise samples was collected during 1971 and 1972 on the vertical, North–South, and East–West components of the VLPE seismographs. The results of converting these samples to root mean square ground motion estimates, averaging the conversions, and computing intercomponent cross-correlations across the 13.5 to 62.5 second period are presented. The results of the study show that the power across the band is not highly correlated among components, that the RMS ground motions approximate a log normal as opposed to normal distribution, and that the vertical noise field has a lower longterm average than the horizontal field. The "noise window" at periods between 20 and 40 seconds also appears to be narrower for the horizontal field than the vertical field. (auth)

26812 (AD-769909) ELECTRON ENERGY DEPOSITION IN ATMOSPHERIC GASES. Technical Report, 15 August 1972–31 May 1973. Lunn, P. W. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Oct 1973. 143p. (AFWL-TR-73-173). NTIS $4.50.

To compute state-by-state electron-impact cross sections, energy loss functions, and secondary electron distributions in energy regions where little or no experimental data exist, an electron energy deposition code (HARMONY) was developed that extends the available low-energy (below 1 to 10 keV) state-by-state calculations out to 10 MeV. The resulting energy loss functions agree quite well with the available experimental or theoretical data. The HARMONY code is presented and the energy regions for each of nine atmospheric gases are discussed for which a Born approximation and a modified Born approximation were used. Since the HARMONY code is based on the University of Florida Aeronomy Group's AURORA code, a low-energy code, emphasis is placed on the improvements made for intermediate and high energies, which include a bremsstrahlung loss and relativistic modifications. (auth)

26813 (AD-769921) INITIAL DUST LOFTING: SHOCK TUBE EXPERIMENTS. Final Report. Ausherman, D. R. (TRW Systems Group, Redondo Beach, Calif. (USA)). 11 Sep 1973. Contract DNA001-72-C-0120. 81p. (DNA-3162-F). NTIS $3.75.

Shock tube experiments were performed to investigate the initial dust lofting process which occurs in a nuclear burst as the blast wave travels over the soil surface. The dust-density profile above the soil surface was determined by a light extinction technique for peak-shock overpressures ranging from 15 to 75 psi. High-speed motion picture films were used to record dust beads ranging from 1 mm to 3 mm in diameter for shock overpressures of 15 to 90 psi. (auth)

26814 (AD-770929) CODE FOR ANALYSIS OF NUCLEAR EFFECTS AND SYSTEMS SURVIVABILITY. Volume III. Blast and Thermal. DeRaad, R. G.; Meisterling, H. E. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Jun 1973. 54p. (GNE/PH-73-3). NTIS $4.75.

Thesis.

A description of a computer code which calculates effects due to a nuclear burst, and determines the survivability of up to 100 selected vehicle positions is described. The effects calculated are those due to x-rays, neutrons, gammas, induced gammas, blast, and thermal. The code accepts as input: (1) the number and spectra of the nuclear bursts; (2) the vulnerability of the vehicles (one type at a time) to the various effects; and (3) the mission profile (initial positions and velocity vectors). The code then computes the level of each effect from each burst at each target position. If any effect level exceeds the vehicle's given vulnerability, that vehicle is assumed to be killed. The code is written in FORTRAN Extended for the CDC 6600 computer. (auth)

26815 (EERL-TR-E-74-1) PROJECT TRINIDAD: EXPLOSIVE EXCAVATION OF RAILROAD CUTS 2 AND 3 BY MOUNDING AND DIRECTED BLASTING. Final Technical Report. Lattery, J. E. (Army Engineer Waterways Experiment Station, Livermore, Calif. (USA). Explosive Excavation Research Lab.). Jan 1973. 39p. Dep. NTIS $4.00.

The objectives, design, and results of two explosive excavation experiments performed as the final phase of Project Trinidad, a comprehensive series of tests to determine the cratering properties of interbedded sandstones and shales, are summarized. The experiments were performed in September 1971 by the U.S. Army Engineer Waterways Experiment Station Explosive Excavation Research Laboratory. These final experiments were designed to excavate through-cuts for relocation of the Colorado and Wyoming Railroad at the Trinidad Dam and Lake Project. The first of the two experiments tested a charge array designed to break up material within a 19,000-yd^3 cut to facilitate later removal of the material by mechanical means. The concept tested was mounding, a blasting technique in which charges are positioned with respect to the horizontal ground surface rather than a vertical bench face. The results from this experiment confirmed the applicability of empirical scaling methods to the design of an array of deeply buried charges. The second experiment was a directed blasting detonation that was designed to produce a 30,000-yd^3 through-cut by cratering. This experiment tested a charge array design that had been developed by a combination of empirical scaling and kinematical methods. (auth)

26816 (FOA-4-4564-A-1) SEISMIC EVENT IDENTIFICATION BY NEGATIVE EVIDENCE. Elvers, E. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Feb 1974. 58p. Dep. NTIS (U.S. Sales Only) $6.00.

A decision-theoretical model for seismic discrimination between earthquakes and underground nuclear explosions is developed. The influence of long and short period detection thresholds on the probabilities to identify explosions and to make false alarms is discussed. The model includes identification by negative evidence. This kind of identification is considered in the case when only short period data are available and when the long period signal amplitude is supposed to be less than or equal to the seismic noise amplitude. For one set of data—obtained from North American events at the Hagfors Observatory in Sweden—the applicability of the m(M) method is increased about half a magnitude by including identification by negative evidence. (auth)

26817 (INIS-mf-1117, pp 37-39) USE OF PEACEFUL NUCLEAR EXPLOSIONS BY ENGINEERS. Wilkin, W. J. 1973.

From forty-fifth congress of Australia and New Zealand Association for the Advancement of Science; Perth, Australia (13 Aug 1973).

The use of nuclear energy in cratering explosions and for contained explosions is described. A discussion is given of the difficulties associated with the use of nuclear explosions and of the problems peculiar to excavations by nuclear explosions. Safety and cost factors are considered. (INIS)

26818 (PNE-RB-53) RIO BLANCO SEISMIC EFFECTS. Navarro, R.; King, K. W.; Brockman, S. R.; Wuollet, G. M. (Geological Survey, Washington, D. C. (USA)). 1974. 100p. Dep. NTIS $7.00.

For CER Geonuclear Corp., Las Vegas, NV.

Personnel of the United States Geological Survey, Seismic Engineering, instrumented and recorded the seismic signal from the three simultaneously detonated 30-kiloton nuclear charges at 35 temporary seismograph stations. The stations were at distances ranging from 5.26 to 148.9 km, and all except one in Bonanza, Utah were located in the state of Colorado. Results of the recordings are presented. (TFD)

26819 (SLL-74-206) PLOWSHARE PROGRESS REPORT FOR QUARTER ENDING DECEMBER 31, 1973. (Sandia Labs., Livermore, Calif. (USA)). Feb 1974. Contract AT(29-1)-789. 6p. Dep. NTIS $4.00.

Progress during October through December 1973 in the Plowshare Project is reported. Information is included on the development of arming and firing components capable of surviving 2 to 6 months at temperatures from 250 to 300°F; development of advanced control switch systems for future Plowshare applications; continuing efforts to improve the safety and security of the Safe-Secure Trailer and other elements of the AEC/ALO transportation system; and consideration of the desirability of a destruct system. (LCL)

26820 (UCRL-51512) COST AND FEASIBILITY OF STIMULATING TIGHT GAS RESERVOIRS WITH CHEMICAL EXPLOSIVES. Higgins, G. H.; Butkovich, T. R.; Montan, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Jan 1973. Contract W-7405-eng-48. 16p. Dep. NTIS $4.00.

Long, continuous, cylindrical charges of high explosives are considered as alternatives to nuclear explosives or massive hydraulic fracturing for the stimulation of gas production in tight gas formations. The calculational method was that used previously for nuclear stimulation; it was verified by comparison of the calculated and observed gas production from Rulison. The calculations indicate that charges of high explosives 24 inches in diameter and 2000 feet in length (the height assumed for the gas-bearing sands) detonated in four wells per section would be comparable in cost and effectiveness to estimates for one well stimulated by three 100-kiloton nuclear explosions. Stimulation by high explosives would require special development of the explosives (probably with ammonium nitrate as the base) to be suitably sensitive, temperature-resistant, and compatible with the gas-reservoir rocks; the required work appears to be straightforward, however. Comparative field testing is required to determine the optimum method (chemical or nuclear explosives or hydraulic fracturing) for a given region and to confirm that gas can be produced profitably for between 25¢ and 80¢ per Mcf. (auth)

26821 NEAR-NUCLEAR COUNTRIES AND THE NPT. Stockholm; Alqvist and Wiksell (1972). 130p.

This paper describes the attitudes of fifteen key near-nuclear countries to the Non-Proliferation Treaty and thereby helps to assess the risks of proliferation of nuclear weapons. It consists of three sections. The first, General Background, presents the problem and provides the necessary background information. Section II contains case studies of the positions of fifteen near-nuclear countries which either have not signed the Non-Proliferation Treaty or, if they have signed it, have not yet ratified it. Section III sums up the conclusions to be drawn from the study. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

26822 (ORNL-4935) ENVIRONMENTAL SCIENCES DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 30, 1973. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 165p. Dep. NTIS $7.60.

Progress for the one year period ending 30 September 1973 in fourteen projects at ORNL is reported. A separate abstract was prepared for each of 10 project reports. The remaining four reports on modeling of a deciduous forest, handling of environmental information, educational activities, and forest management were not within the scope of NSA. (LCL)

For abstracts of individual sections see: 26830–26833, 26857, 26858, 26864, 26876, 26877, and 27425.

Minerals and Ores

26823 PRICE DETERMINATION AND DEVELOPMENTS FOR THE PRINCIPAL METALS AND MINERALS: NATURAL URANIUM. Blanc, J. (CEN, Chatillon, France). Ann. Mines; 81-83(Oct 1973). (In French).

The different stages of the nuclear fuel cycle are recalled. Only the commercial aspects of the first stage leading to the sale of high U content concentrates and UF_6 are then considered. The natural uranium concentrates market is currently dominated by the USA and several large world producers. It is not expected that the natural U consumption will exceed the production capacities of already existing plants and envisaged plants (combined estimate of from 30 to 40,000 tons per year) before 1976. This situation is reflected by the recent drop in price (8 to 6 dollars per pound of U_3O_8) for deliveries between 1972 and 1978. (FR)

26824 ELLIOT LAKE URANIUM DEPOSITS OF CANADA. Maciaszek, Z. Rudy Metale Niezelaz.; 18: No. 9, 447-448(Sep 1973). (In Polish).

A brief characteristic is given of Elliot Lake (named also Blind River or Algoma) uranium deposits. Thorium and rare earth metals occur as admixtures. The resources of the deposit rank among the largest in the world. The genesis of the deposit is controversial and requires further study. (auth)

26825 RADIOACTIVE LIMONITE OF LOTA PAHAR, SINGHBHUM DISTRICT, BIHAR. Subramanyan, V. (Saugar Univ., India). J. Geol. Soc. India; 13: No. 4, 329-338(1972).

Transported, radioactive (up to about 1,000 ppM of U) limonite occurs in Lota Pahar, which is shown to be the westernmost extension uranium mineralization in the Singhbum thrust belt. Limonite might have acquired the uranium content by the adsorption of uranyl ions on the colloidal ferric oxide hydrate. This radioactive limonite served as a prospecting aid in the discovery of uraniferous breccia in the Lota Pahar ridge and the environs. (24 references) (Indian Sci. Abstr.)

26826 APPLICATION OF GAMMA SPECTROSCOPY FOR STUDYING MAGMATIC ROCKS OF THE TAMDZENSKIAN AND KURAMINIAN MOUNTAINS (UZBEKISTAN). Magdiev, R. A. Uzb. Geol. Zh.; No. 2, 68-71(Feb 1973). (In Russian).

The content of U (according to Ra), Th, and K in magmatic rocks was studied by using the SP-3 instrument in the surface γ-spectrometry of natural outcrops. Measurements in laboratory conditions of the radioactive elements content were made by four methods (luminescence, radiochemical, flame photometric, and spectrometric). The convergence of the field and laboratory studies was established. It is concluded that the SP-3 instrument can be used for the study of the Clark and sub-Clark concentrations of radioactive elements in rocks of different composition without special sampling. Data on the concentration of radioactive elements can also be used for making more precise determinations of the age, the mineralization zone, etc. (tr-auth)

26827 URANIUM INDUSTRY, EXPLORATION, MINING, AND MILLING. Youngberg, E. A. (Atomic Energy Commission, Grand Junction, CO). IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 4, 1201-1208(1973).

The paper describes in more general terms, for the interested engineer and executive not directly concerned with the raw material aspects of uranium, a review of the technology of finding and producing uranium, and the United States uranium resources. (auth)

26828 URANIUM AND THORIUM. Groenlands Geol. Unders. Rap.; No. 56, 25-29(1973).

A survey is given of uranium and thorium deposits in Greenland. (DE)

Radioactive Effluents

Refer also to abstracts 26857, 28635, 28767, 28770, 28773, 28774, 28777, and 28778.

26829 (CEA-CONF-2465) RADIOECOLOGICAL STUDY OF THE CONSEQUENCES OF NUCLEAR WASTES IN AN IMPORTANT RIVER BASIN. Houcelle, M.; Mercier, C.; Revol, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France)). [nd]. 19p. (In French). (CONF-730984-1). Dep. NTIS (U.S. Sales Only) $3.00.

From European study group of radioprotection and of protection of the environment; Budapest, Hungary (3 Sep 1973).

The following sources of radioactivity in the Rhone basin are discussed: nuclear research installations; uranium isotope separation plants; plants for treatment of nuclear fuels; and nuclear reactors. The importance of studies on mechanisms of radionuclide discharge and transfer pathways in the basin is pointed out. The dominant role of the utilization of water in the estimation of risks is emphasized. Laboratory experiments and in situ research have been concerned with: hydrology studies; radioactive contamination of living organisms in the environment and evaluation of concentration factors; studies on mechanisms of fixation and diffusion of radionuclides in the soil introduced by irrigation; and studies on radionuclide migration in irrigation water. A study of radionuclide distribution in the Rhone basin included dispersion of ^{90}Sr and ^{137}Cs in the river; radioactive contamination of aquatic organisms and use of the eel as an indicator of pollution; and contamination of agricultural plants with ^{90}Sr, ^{137}Cs, and other radionuclides. Studies on soil contamination included mechanisms of transfer of ^{137}Cs and ^{90}Sr in various types of soil. The roles of dilution and dispersion in reducing the hazards of radioactive contamination are discussed. (HLW)

26830 (ORNL-4935, pp 1-11) ENVIRONMENTAL HAZARDS STUDIES. Kaye, S. V.; Barton, C. J.; Booth, R. S. Mar 1974.

In Environmental Sciences Division annual progress report for period ending September 30, 1973.

Considerable progress was made in developing a computer code to calculate CUEX indices for application as radiation protection guides for environmental releases. The CUEX code now incorporates atmospheric dispersion, transport through the terrestrial food chains, and internal and external dosimetry. Work is in progress to incorporate in the CUEX code already developed hydrologic, aquatic, and sediment models. The environmental transport and radiation dosimetry models developed under the CUEX project were used extensively in making radiological predictions for incorporation in environmental statements prepared in response to the NEPA. These activities included assessments for reactors, fuel fabrication plants, fuel reprocessing plants, mining and milling, and consumer products containing radioactive sources. The variety of these applications required development of new capabilities in environmental transport modeling and dosimetry for radionuclides which were new to this program. An important study was concluded on the hypothetical use of nuclearly stimulated gas from wells in the Rulison field in Colorado. The predicted maximum dose to an individual in that area from combustion products resulting from home use and electricity generation in a large gas-fired plant was less than 1 millirem/year. (auth)

Radioactivity Monitoring and Transport

Refer also to abstracts 28767, 28769, 28770, 28771, 28773, 28777, 28778, and 28865.

26831 (ORNL-4935, pp 34-45) AQUATIC ECOSYSTEM STUDIES. Blaylock, B. G.; Allen, C. P.; Elwood, J. W. Mar 1974.

In Environmental Sciences Division annual progress report for period ending September 30, 1973.

In aquatic ecosystem studies, investigations were carried out in radionuclide cycling, radiation effects, and toxicant formation in condenser cooling systems. Experiments in radionuclide cycling demonstrated the availability of radionuclides from bottom sediments to the aquatic food chain and provided information on the transport of radionuclides in aquatic ecosystems. The effects of chronic low-level radiation on aquatic biota and the frequency of abnormalities in the fish populations of White Oak Lake were

considered in radiation effects studies. Studies on toxicant formation in condenser cooling systems included the development of techniques for identifying and quantifying chlorinated organic constituents in water and testing the toxicity of specific chlorine-containing compounds on aquatic biota. These laboratory and field studies are oriented toward providing information to evaluate the ecological consequences of planned or accidental releases of radionuclides and toxicants to aquatic ecosystems. (auth)

26832 (ORNL-4935, pp 46-60) TERRESTRIAL RADIONUCLIDE CYCLING AND EFFECTS. Dahlman, R. C.; Anderson, S. H.; Andrews, H. H. Mar 1974.

In Environmental Sciences Division annual progress report for period ending September 30, 1973.

Research progress on radionuclide cycling includes studies of the mechanism of strontium sorption-desorption by soils from the southeastern United States. Results indicate that strontium adsorption by clays may be related to the same sites which bond organic matter. The Aspergillus niger technique was used to determine available ^{137}Cs in soil; concentration factors (1.2×10^{-2}) for the fungus were very similar to those determined by continuous cropping of White Oak Lake soil by millet (2 to 3×10^{-2}). Distribution and transport of radionuclides leaking from a waste trench were investigated at the Oak Ridge burial grounds. It was discovered that ^{60}Co is complexed with EDTA from the contaminated waste. The fraction of ^{60}Co in vegetation of the radioactive seep was only 1% of the total determined for soil plus biotic components. Ground cover, Impatiens biflora, contained more ^{60}Co than all trees growing in the seep. Results were obtained on the kinetics of ^{60}Co and ^{137}Cs in mineralization immobilization by decomposer organisms. The influence of microorganisms and decomposability of organic substrate on radionuclide availability to higher plants were investigated. The influence of food type on the food chain bioaccumulation of ^{60}Co and ^{137}Cs in quail was determined. Responses of arthropod populations to in situ exposures were investigated for 2 to 13 rads/day dose rates. Results on the environmental fate and effects of chemicals from cooling-tower drift include studies of chromium from ORGDP towers and effects of salt from simulated applications of brackish water to forest species. Maximum chromium concentrations in grass and tobacco were 400 and 200 μg/g respectively. Effects on tobacco growth were observed at concentrations averaging 10 μg Cr per gram at 200 m from the towers. No effects on trees from experimental salt applications at rates below 100 lb/acre were observed, but photosynthesis was markedly depressed in all species at a cumulative application of 900 lb/acre. (auth)

26833 (ORNL-4935, pp 61-65) PLUTONIUM RESEARCH AND APPLIED STUDIES. Reichle, D. E.; Bondietti, E. A.; Dahlman, R. C. Mar 1974.

In Environmental Sciences Division annual progress report for period ending September 30, 1973.

This is a new project this year, designed to explore the behavior of plutonium on mesic and humid environments of the eastern United States. Most existing knowledge on the environmental fate of plutonium has been derived from releases in sparsely populated arid environments. However, future uses of plutonium will occur in closer proximity to larger human populations and cultivated land. Intention to locate the first liquid metal fast breeder reactor (LMFBR) in the eastern United States (Tennessee), and locating a waste processing facility (Barnwell, South Carolina) in the Southeast, are examples of the expansion of plutonium facilities into new and different environments. Knowledge on plutonium behavior in these different environments will be needed because new sites of plutonium technology eventually will be located in mesic, subhumid regions of the eastern United States. Physical characteristics of these environments and related biotic behavior are significantly different from those of arid regions. (auth)

26834 (ORNL-TM-4510) RELEASE OF TRITIUM FROM TRITIATED PAINTS. Niemeyer, R. G. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 16p. Dep. NTIS $4.00.

A study of the tritium losses from five tritiated phosphor paints showed that the losses from these paints were generally low. Samples of five different paints which were leach tested six times over a period of 11 months had losses ranging from 0.018 to 0.731% of the initial activity in the samples. Tritium evolved from a paint which had been cured for 3 months after application was 0.011% of the initial activity during a 9-hr sampling period. Tritium evolved from two groups of wrist watches having painted disks or hands and maintained at body temperature (98.6°F) was 0.238 and 0.058 μCi/day watch. Losses during paint drying at 28°C during a 4.5-hr period ranged from 0.142 to 2.32% of the initial activity. Tests were also made to determine the effects of paint thickness and exposed surface area on the losses. (auth)

26835 IODINE-129 LEVELS IN MILK AND WATER NEAR A NUCLEAR FUEL REPROCESSING PLANT. Daly, J. C.; Goodyear, S.; Paperiello, C. J.; Matuszek, J. M. (New York State Dept. of Health, Albany). Health Phys.; 26: No. 4, 333-342(Apr 1974).

Detection of substantial ^{129}I concentration in animal thyroids collected in the environs of a nuclear fuel reprocessing plant in West Valley, New York, signified a general buildup of ^{129}I in the environment surrounding the plant. Concern for a possible public health problem led to the development of a program to establish ^{129}I levels in milk and water in cooperation with the New York State Department of Environmental Conservation. Surveillance for ^{129}I in milk was begun in September 1971. In a 12-month period the ^{129}I levels in 95 milk samples from farms surrounding the nuclear fuel reprocessing plant ranged from nondetectable (<0.3 pCi/l.) to 2 pCi/l. In addition, 111 water samples collected between June 1971 and July 1972 from streams draining the plant site were analyzed for ^{129}I. Samples from Buttermilk Creek, which is on the plant site, showed ^{129}I concentrations up to 7.7 pCi/l. The impact of ^{129}I in the environment surrounding the plant is evaluated. Estimates of dose commitment are provided and are compared, for adults, to radiation protection guides. Recommendations are offered to reduce the potential public health hazard, principally by limiting the release of ^{129}I levels to the biosphere. (auth)

26836 DATA. Section IV. Other Data. Radiat. Data Rep.; 15: No. 2, 89-102(Feb 1974).

Environmental radiation monitoring data obtained at the Lawrence Berkeley Laboratory and at the Savannah River Plant during the period from January through December 1971 are presented. The January 30, 1974 detection in the US of seismic signals presumed to have originated from an underground nuclear explosion in the USSR is reported. (LCL)

Atmosphere

26837 (AD-763196) MECHANISMS OF FALLOUT PARTICLE FORMATION: ANNUAL PROGRESS REPORT FOR PERIOD ENDING JUNE 1971. Benck, R. F.; Crisco, C.; Mastrangelo, C. J.; Pope, S. V.; Runquist, A. W. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Jun 1973. 47p. (BRL-MR-2304). NTIS $3.75.

Progress during FY 71 at the Army Ballistic Research Laboratories on studies of the mechanisms of the fallout particle formation are presented. The program emphasis has been on understanding the attachment (e.g., nucleation or condensation) of gaseous fission product elements onto various solid substrates. Several precise techniques have now been developed to study these phenomena and the agreement among the techniques is very satisfactory. The results obtained are significant in interpreting the radioactive distribution observed in fallout particles and in making general predictions regarding condensation behavior on oxide and metal substrates. (GRA)

26838 (CEA-CONF-2539) NEW DATA CONCERNING THE SAFETY OF MINERS IN URANIUM MINES. Pradel, J.; Zettwoog, P.; Madelaine, G.; Francois, Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1973. 8p. (In French). (CONF-730907-19). Dep. NTIS (U. S. Sales Only) $3.00.

From third international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

Results are reported from studies on the action of radon and its daughter elements in an experimental uranium mine at La Crouzille. The efficiency of a new portable individual dosimeter to measure the exposure of uranium miners to radon elements was tested. (auth)

26839 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 15: No. 2, 79-88(Feb 1974).

October 1973 measurements of the gross β-activity in surface air and precipitation at 16 sampling stations in the US and 24 stations in Canada and for the gross β-activity in surface air only at 72 US and 12 Pan American sampling stations are presented. (LCL)

26840 PLANETARY DISTRIBUTION OF THE LEAD-210 AND POLONIUM-210 CONCENTRATION IN THE LOW STRATOSPHERE AND ITS USE FOR THE EVALUATION OF TRANSFER PARAMETERS. Karol, I. L. Tr. Gl. Geofiz. Observ.; No. 315, 46-60 (1973). (In Russian).

Published results of the airplane measurements of the concentration of the natural radioisotopes ^{210}Pb and ^{210}Po in the zone from 70°N to 50°S of the western hemisphere up to a level of 20 km

are analyzed. The seasonal changes of the medium-zone transfer of the isotopes between different parts of the stratosphere were determined. An evaluation is given of the transfer parameters for decreased northern latitudes in the previously proposed scheme of the global transfer of impurities. (tr-auth)

Soil

26841 (BNWL-1720) PERCOL USER'S MANUAL. Serne, R. J.; Routson, R. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 80p. Dep. NTIS $5.45.

For Atlantic Richfield Hanford Co., Richland, Wash.

Research being conducted under the Radionuclides in Soils Program is attempting to predict the distribution and movement of liquid wastes in the heterogeneous subsurface environment of the Hanford Reservation. As part of this program, a transport model is being developed to predict chemical phenomena in soil-waste reactions. This document describes the use of the PERCOL model, which was developed as a simplified one-dimensional precursor to the transport model. PERCOL numerically describes the complex chemical reactions which occur during percolation of a waste solution through a porous media. This User's Manual describes the main program (PERCOL) and two subroutines (NEWTIT and DIST) and gives procedures for accessing these programs, inputting data to them and interpreting the output. (auth)

26842 (TID-26520) EXCERPTS FROM SRL MONTHLY REPORTS ON WASTE MANAGEMENT. (Du Pont de Nemours (E.I.) AND CO., AIKEN, S. C. (USA). Savannah River Lab.). Aug 1970. 26p. Dep. NTIS $3.50.

Savannah River Plant burial trenches for solid wastes were monitored for water content and ^{90}Sr concentrations. Information is included on: the downward movement of waste in soil below storage tanks; leaching of crystalline waste through simulated storage tank crack; soil permeability; simulation of waste flow into the ground; water flow through soil beneath seepage basins; observed and calculated seepage from K-area retention basin; radioactivity in vegetation and soil due to ^{90}Sr migration; ^{89}Sr and ^{90}Sr in rabbits and mice in the burial ground; and the absorption of ^{90}Sr and ^{137}Cs by kaolin clay. (LCL)

26843 ^{60}Co SORPTION IN SOIL. Khodzhaeva, L. I.; Kurovich, V. N.; Videnskaya, M. M. Gig. Sanit.; No. 10, 106-107(Oct 1973). (In Russian).

The behavior of carrier-free ^{60}Co in several types of soil was studied in the laboratory in glass columns through which an aqueous solution of ^{60}Co was passed. The percent of Co in the effluent was constant regardless of the activity of the original solution. Examination of the column after passage of the solution showed that more than 95% of its activity was on the first 3 cm for sandy loam, loam, and filled earth, with about 72% in coarse sand and 57% in fine sand. Desorption with water was insignificant. Coefficients of distribution of the radioisotope between water and soil, calculated under static conditions, varied from 330 to 800 in drinking water and from 400 to 1100 in distilled water. (TTT)

Water

Refer also to abstract 26829.

26844 (TID-26517) EXCERPTS FROM SRL MONTHLY REPORTS ON WASTE MANAGEMENT. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Jun 1967. 9p. Dep. NTIS $3.00.

Miscellaneous data on environmental radiation monitoring near waste storage areas at the Savannah River Plant are presented. Information is included on: soil and water contamination at the waste storage site; ^{137}Cs content in waters and sediments of the Savannah River and Four Mile Creek as the result of a high-level liquid waste spill; and the contamination problems which resulted from the railway shipment of irradiated electrical cables from hot cells to a burial ground. (LCL)

26845 DATA. Section II. Water. Radiat. Data Rep.; 15: No. 2, 74-78(Feb 1974).

Data from radiation monitoring during October 1973 of surface, ground, and drinking waters sampled in California, Nevada, and Utah are reported. (LCL)

26846 TRANSIENT EXCESS-RADON PROFILES IN PACIFIC BOTTOM WATER. Chung, Y. C. (Univ. of California, San Diego, La Jolla). Earth Planet. Sci. Lett.; 21: No. 3, 295-300(Feb 1974).

Five near-bottom excess-radon profiles have been measured at the Geosecs-I station in the northeast Pacific, at varying intervals over a period of two and a half years. These profiles vary considerably in both structure and radon concentration, indicating transient characteristics of the bottom water in the deep Pacific. Only two of the five profiles are of the quasi-exponential type (Y. Chung and H. Craig); the stationary vertical eddy diffusivities calculated from these two profiles are 129 cm^2/sec in November 1971, and 22 cm^2/sec obtained five months later. A single bottom-radon profile was measured in the western-boundary-current region of the South Pacific at the Geosecs-III station. This profile is also of the quasi-exponential type, with a vertical diffusivity of 32 cm^2/sec. Although the radon concentrations of the three quasi-exponential profiles and the calculated diffusivities are quite different, the integrated excess-radon inventory in the water column, and the calculated flux of radon across the sediment–water interface, vary by only a factor of two in the two areas studied. (auth)

26847 URANIUM DEPOSITION AND ^{234}Th ALPHA-RECOIL: AN EXPLANATION FOR EXTREME $^{234}U/^{238}U$ FRACTIONATION WITHIN THE TRINITY AQUIFER. Kronfeld, J. (Rice Univ., Houston). Earth Planet. Sci. Lett.; 21: No. 3, 327-330(Feb 1974).

^{234}Th alpha-recoil appears to be a valid mechanism for explaining the generation of extreme $^{234}U/^{238}U$ disequilibria found in the waters of the Trinity aquifer. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 26859, 27132, and 28903.

26848 DATA. Section I. Milk and Food. Radiat. Data Rep.; 15: No. 2, 53-73(Feb 1974).

Data are reported on the: ^{137}Cs and ^{90}Sr content in milk at 63 sampling stations in the US, 16 stations in Canada, and 7 stations in Central and South America for October 1973 and for the 12-month period from November 1972 to November 1973; the radioisotopes content in milk from California, Nevada, and Utah sampled during October 1973; the radioisotopes content in North Carolina milk sampled during the period from January 1967 through August 1973; and the radioisotopes content in California diets sampled during the period from July 1971 through December 1973. (LCL)

26849 NITROGEN TRACERS IN NITROGEN CYCLE STUDIES: PAST USE AND FUTURE NEEDS. Hauck, R. D. (Tennessee Valley Authority, Muscle Shoals, AL). J. Environ. Qual.; 2: No. 3, 317-327(1973).

Nitrogen research is directed toward two main objectives, food and fiber production and environmental control. To achieve N balance in productive ecosystems, better quantitative estimates of N transformation rates are needed. Nitrogen tracers are indispensable for making many of these estimates. Either ^{15}N-depleted or ^{15}N-enriched materials can be used. The use of ^{15}N-depleted materials is limited to studies where dilution from other N is less than 2,000-fold, but these materials are potentially available in ton amounts. Use of variations in natural ^{15}N abundance may be useful in observing qualitative relationships among N cycle processes over large areas or extremely long time periods. Such use is questionable for obtaining quantitative information for short-term N transformation processes. Obvious information gaps are quantitative data on atmospheric N_2 fixation and denitrification in cropped field soils and N transformation data for many other ecosystems. A program for computer data retrieval and correlation is outlined. (auth)

Radiometric Techniques

Refer also to abstracts 26849, 26895, and 26922.

26850 PROBLEMS OF THE RADIOCARBON CALENDAR AND ITS CALIBRATION. Renfrew, C.; Clark, R. M. (Univ. of Southampton, Eng.). Archaeometry; 16: No. 1, 5-18(Feb 1974).

Both the growing body of literature on the tree-ring calibration of radiocarbon dates and the variety of statistical approaches used, make it appropriate to review the basic principles involved in the construction of a calibration curve. While its ultimate validity is in part a geophysical problem, the appropriate form for the calibration function, given a specific body of data, is a statistical question centering upon the analysis of the measurement errors involved. The relationship between the calibration function and the inverse calibration function is examined, and the shortcomings of the available published calibration curves considered in the light of this examination. It is concluded that there is no reason to doubt the general principles on which the calibration is based, but a need exists for a more critical handling of the measurement data with a statistical treatment of the errors involved. The quality of the data could itself be improved by the use of replicate samples for inter-

laboratory projects specifically designed to investigate the magnitude of measurement error. (auth)

26851 HIGHLY ENRICHED MULTIPLY-LABELED STABLE ISOTOPIC COMPOUNDS AS ATMOSPHERIC TRACERS. Goldblatt, M.; McInteer, B. B. (to United States Atomic Energy Commission). US Patent 3,788,814. 29 Jan 1974. Filed data 1 Feb 1972. 4p.

Compounds multiply-labeled with stable isotopes and highly enriched in these isotopes are readily capable of detection in tracer experiments involving high dilutions. Thus, for example, $^{13}C^{18}O_2$ provides a useful tracer for following atmospheric pollution produced as a result of fossil fuel burning. (Official Gazette)

26852 PRODUCTION OF RADIOCARBON IN TREE RINGS BY LIGHTNING BOLTS. Libby, L. M. (R and D Associates, Santa Monica, CA); Lukens, H. R. J. Geophys. Res.; 78: No. 26, 5902-5903(10 Sep 1973).

Lightning bolts appear to be able to produce neutrons by processes associated with the acceleration of ions to an amount estimated to be about a percent of the cosmic ray neutron production. The corresponding effect on radiocarbon in tree rings can explain the well-known short-term secular errors in radiocarbon dates as being caused by climatological fluctuations in frequency of lightning storms. (auth)

26853 ISOTOPIC TRACER TECHNIQUES FOR IDENTIFICATION OF SOURCES OF NITRATE POLLUTION. Edwards, A. P. (Tennessee Valley Authority, Muscle Shoals, AL). J. Environ. Qual.; 2: No. 3, 382-387(1973).

A comparison was made of the use of natural variations in ^{15}N abundance vs. ^{15}N-enriched and ^{15}N-depleted fertilizers in determining the contribution of inorganic ammonium fertilizers to the NO_3-N extracted from a Webster soil following a 30C aerobic incubation for 2.5 weeks. The natural abundance approach was unsatisfactory even in this simplified system and its lack of success is shown to be due in part to replicate variability. The fluctuations in ^{15}N-content of the nitrate from carefully replicated samples of each fertilizer treatment were of the same order of magnitude as the mean difference between the ^{15}N-contents of natural fertilizer-N and the soil-derived NO_3-N. Therefore, the use of labeled fertilizers with ^{15}N-contents substantially higher or lower than the natural abundance figure is the only valid approach to the measurement of fertilizer contribution to the NO_3-N appearing in tile drains under field condition. (auth)

26854 NITROGEN-15 ENRICHMENT OF SOILS AND SOIL-DERIVED NITRATE. Bremner, J. M.; Tabatabai, M. A. (Iowa State Univ., Ames). J. Environ. Qual.; 2: No. 3, 363-365(1973).

Nitrogen-isotope analysis of soils and soil-derived nitrate showed (i) that there is considerable variation in the ^{15}N enrichment ($\Delta\ ^{15}N$) of the nitrate nitrogen produced on aerobic incubation of different soils and (ii) that the $\Delta\ ^{15}N$ of this nitrate nitrogen depends upon the time of incubation and can differ markedly from that of the total soil N. The data reported illustrate the impracticability of a recently proposed method of assessing the contribution of fertilizers to nitrate in surface waters that requires measurement of the natural ^{15}N enrichment of soil- and fertilizer-derived nitrate. (auth)

26855 INDEPENDENT DATING (U.Th.Pb) OF ZIRCON GRAINS USING ISOTOPIC DILUTION. Geological Implications. Lancelot, J. R.; Vitrac, A.; Allegre, C. J. (Univ., Paris). Compt. Rend., Ser. D; 277: No. 20, 2117-2120(19 Nov 1973). (In French).

Zircon populations are not always simple and homogeneous but often occur as complex mixtures. A detailed analysis of this problem was made, the question of independently analyzing each grain of zircon without losing the advantages of conventional isotopic analysis (i.e., the possibility of comparing the three apparent ages) being studied. The analytical technique developed is presented. (FR)

26856 SYSTEMATICS IN URANIUM–IONIUM DATING OF SEDIMENTS. Bernat, M.; Allegre, C. J. (Univ., Paris). Earth Planet. Sci. Lett.; 21: No. 3, 310-314(Feb 1974).

The mineral separates of a core were systematically dated by the Io/Th chronology method. The results show that authigenic minerals, though not always completely authigenic, are suitable for dating. Some evidence is given against the hypothesis of $Io/^{232}Th$ isotopic equilibrium in marine conditions and suggest that the minerals are mixtures of two components. (auth)

Site Surveys

Refer also to abstracts 23739, 28740, 28770, 28773, and 28776.

26857 (ORNL-4935, pp 19-23) ENVIRONMENTAL ANALYSIS AND ASSESSMENT. Nelson, D. J.; Blaylock, B. G.; Boegly, W. J. Mar 1974.

In Environmental Sciences Division annual progress report for period ending September 30, 1973.

The work of the ORNL staff in preparing environmental impact statements is reviewed. Current activities indicate that statements for 10 to 15 nuclear power plants are in preparation at any one time. Studies are also being made on relation of design blowdown rate to expected radioiodine release in gaseous effluents from a PWR, reactor safety, and radiological impact of changing form of radioiodine. (LCL)

26858 (ORNL-4935, pp 85-97) INTERNATIONAL BIOLOGICAL PROGRAM: OAK RIDGE SITE. Harris, W. F.; Anderson, R. M.; Ausmus, B. S. Mar 1974.

In Environmental Sciences Division annual progress report for period ending September 30, 1973.

The Oak Ridge Site of the U.S.-IBP Eastern Deciduous Forest Biome is one of five major research efforts, with the primary objectives of quantifying the internal processes of ecosystems, understanding land-water geochemical interactions, and modeling the dynamics of whole ecosystems. Project activities this past year involved the completion of field research on the structure and function of forest ecosystems in anticipation of extensive data synthesis activities. Research on forest metabolism emphasized analysis of autotrophic respiration, storage carbohydrate dynamics, and belowground processes. Two comprehensive studies on decomposer activities, one emphasizing the cryptozoan food web, the other microbial activities, were completed. The Oak Ridge IBP project has demonstrated the large allocation of photosynthate belowground, the role of root sloughing and root herbivory in biogeochemical cycles, and how simulation models can be used to describe the dynamics of belowground processes. Modeling of ecological systems continued to be an important objective. Summarization of data on biogeochemical cycles led to the construction of linear analytical models of element dynamics. These models were subjected to several system analysis procedures in order to elucidate general properties and time responses of biogeochemical cycles. Other modeling activities included the completion of a simulation model of forest organic-matter dynamics. This model, SERENDIPITY, is presently being coupled with data on element dynamics and plant-soil-water relationships to include the effect of fluctuating climate on forest production–biogeochemical cycling. (auth)

26859 (RLO-2225-T-26-13) NUMERICAL ABUNDANCE OF DOMINANT COPEPODS FROM THE NORTHEAST PACIFIC OCEAN: COLUMBIA RIVER EFFLUENT AREA, 1963. Technical Report No. 286. Jawed, M. (Washington Univ., Seattle (USA). Dept. of Oceanography). Jun 1973. Contract AT(45-1)-2225. 111p. Dep. NTIS $7.75.

Results are presented of analyses of the species composition of copepods of the Pacific Ocean off the coasts of Washington and Oregon. It is based on the examination of 349 zooplankton samples obtained from March to December, 1963, with special reference to the Columbia River plume. Results are presented as number of zooplankton per cubic meter. A checklist of copepod species identified from these samples is also included. (auth)

26860 RADIOACTIVE ISOTOPIC CHARACTERIZATION OF THE ENVIRONMENT NEAR WISCASSET, MAINE: A PREOPERATIONAL SURVEY IN THE VICINITY OF THE MAINE YANKEE ATOMIC POWER PLANT. Hess, C. T.; Smith, C. W.; Kelley, H. A.; Rock, F. C. (Univ. of Maine, Orono). Radiat. Data Rep.; 15: No. 2, 39-52(Feb 1974).

An environmental radioactivity survey was conducted in the vicinity of the Maine Yankee Atomic Power Plant prior to the operation of this facility. Measurements of environmental radioactivity were made on samples of soil, sediment, well water, surface water, estuarine water, air particulates, air moisture, and precipitation. Natural radioisotopes in the uranium and thorium series and ^{40}K were found in most of the samples. ^{137}Cs also was found in some samples. (auth)

26861 ECOLOGICAL NOTES ON MANITOBA NAPAEOZAPUS INSIGNIS. Iverson, S. L.; Turner, B. N. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Can. Field Natur.; 87: No. 1, 15-19(Jan 1973).

As part of a systematic sampling of small mammals within the control area of Whiteshell Nuclear Research Establishment of Atomic Energy of Canada Limited, twenty-six woodland jumping mice (Napaeozapus insignis frutectanus) were captured (1967–71) in a deciduous forest bordering the Winnipeg River and its tributary creeks. Only two specimens of this mammal have been previously reported from Manitoba, and both were from a coniferous forest. The specimens were captured where the dominant vegeta-

tion included hazelnut (Corylus cornuta), trembling aspen (Populus tremuloides), ash (Fraxinus nigra and F. pennsylvanica), oak (Quercus macrocarpa) and strawberry (Fragaria virginiana). All were captured on or near slopes and within 100 m of permanent flowing water. Males apparently emerge from hibernation in late May and are in reproductive condition, whereas females do not emerge until early June. There was no evidence of more than one litter per year, and young did not reproduce in their year of birth. Adults stored fat in August or early September. The species has a restricted distribution in this area, and apparently occurs in isolated groups. (auth)

Thermal Effluents

Refer also to abstracts 28635, 28742, 28770, and 28775.

26862 (BNWL-1530) BEHAVIOR OF ULTRASONIC TAGGED CHINOOK SALMON AND STEELHEAD TROUT MIGRATING PAST HANFORD THERMAL DISCHARGES (1967). Coutant, C. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1973. Contract AT(45-1)-1830. 17p. Dep. NTIS $4.00.

Ultrasonic tagged, adult chinook salmon and steelhead trout were tracked in the Columbia River in 1967 during upstream migration past cooling water discharges from nuclear reactors. All fish migrated near shorelines, showing preference for the river bank opposite reactors. Clear responses to local temperature differences were exhibited by few fish, these responses being to small shoreline seepages rather than to main center-channel outfalls. (auth)

26863 (CONF-731101-56) STATUS OF WASTE HEAT UTILIZATION AND DUAL-PURPOSE PLANT PROJECTS. Beall, S. E. Jr.; Yarosh, M. M. (Oak Ridge National Lab., Tenn. (USA)). 1973. 43p. Dep. NTIS $5.25.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The use of power plant thermal effluents, in the form of warm water or steam, to heat buildings for raising both plant and animal food crops, in aquaculture to produce fish and seafood, in outdoor agriculture, and in industry for distilling water and processing chemicals is discussed and illustrated. Facilities engaged in studying each of these waste heat applications and the results of such studies are described. It is concluded that rising energy costs and diminishing natural supplies of food will provide the incentive for the further development of commercial uses of waste heat from power plants. (LCL)

26864 (ORNL-4935, pp 24-33) POWER PLANT EFFECTS. Coutant, C. C.; Carroll, D. S.; Cox, D. K. Mar 1974.

In Environmental Sciences Division annual progress report for period ending September 30, 1973.

Power plant effects studies encompass thermal and mechanical effects on fish and other aquatic organisms and computer simulation of the effects of fish losses on their populations in selected water bodies. Studies this year have included laboratory testing of thermal requirements for survival, growth, and reproduction; field and laboratory studies of temperature selection and other behavior patterns; studies of the survival of small fish subjected to thermal and mechanical stresses in a simulated power plant condenser tube; and consolidation of all field and laboratory data into models of population responses. (auth)

26865 (ORNL-TM-4150) PROGRAM ESTU: A METHOD FOR ESTIMATING ESTUARINE TEMPERATURE DISTRIBUTIONS FOR HARLEMAN'S CLOSED-FORM, ONE-DIMENSIONAL MODEL. Wichner, R. P. (Oak Ridge National Lab., Tenn. (USA)). Apr 1974. Contract W-7405-eng-26. 44p. Dep. NTIS $5.25.

A method is presented for obtaining accurate numerical results for Harleman's closed-form, one-dimensional estuary model. The model applies to the case of a single-source input, steady net flow, and tidal flow varying sinusoidally with time. Though more sophisticated estuarine computational procedures are now available, this simple, closed-form model may continue to be useful for approximations and parameter surveys. Some general characteristics of temperature distributions as a function of time within the tidal cycle in the vicinity of a warm input are discussed for a typical East Coast estuary. Temperature profiles for 15-min intervals throughout the tidal cycle are plotted revealing some interesting and not well-known features. It is shown that a tidal average maximum temperature peak occurs very close to the location of the outfall for the range of net flows and dispersion coefficients that were examined. (auth)

26866 THERMAL EFFECTS. Coutant, C. C.; Pfuderer, H. A. (Oak Ridge National Lab., TN). J. Water Pollut. Contr. Fed.; 45: No. 6, 1331-1369(Jun 1973).

Data are reviewed from a number of studies on the effects of temperature on aquatic organisms, with emphasis on the effects of thermal effluents from nuclear power plants. Data pertinent to the establishment of water temperature standards for the disposal of waste heat to rivers, lakes, and coastal waters are included. Topics discussed include the long-term biological effects of elevated temperatures; temperature limits for reproduction; the effects of cold shock from power plant shutdowns; the effects of temperature increase on oxygen consumption by organisms in polluted waters; the effects of thermal pollution on primary production of phytoplankton, microbial populations, and the composition of the biotic community; and the effects of thermal effluents on the spawning grounds of species important to man and on the growth rate of species used for human food. (428 references) (CH)

26867 POTENTIAL AUGMENTATION OF PRECIPITATION FROM COOLING TOWER EFFLUENTS. Huff, F. A. (American Meteorological Society, Easton, PA). Bull. Amer. Meteorol. Soc.; 53: No. 7, 639-644(Jul 1972).

The effects of waste heat and water vapor discharged from large cooling towers on augmentation of natural precipitation downwind of the towers is discussed, and estimates of environmental damage caused by the Zion (Michigan) power plant are considered. The meteorological consequences of large amounts of heat energy and water vapor released into the atmosphere from power plants are difficult to assess due to inadequate information. The interaction between tower effluent and the atmosphere is very complex and depends upon local conditions of climate and topography. (Pollut. Abstr.)

26868 ANALYTICAL CONSIDERATION OF UNDERSOIL HEATING. Trezek, G. J.; Obeng, D. (Univ. of California, Berkeley). J. Environ. Qual.; 2: No. 4, 458-462(1973).

The feasibility of using reject heat from electrical power plants for undersoil heating has been analytically considered. Since soil is a poor thermal conductor, a suitable arrangement of undersoil pipes is required in order to achieve a somewhat uniformly elevated soil temperature. Two-dimensional steady temperature profiles in soil resulting from a warm water pipe having a wall temperature of 37.8C were computed for several pipe configurations and surface heat transfer coefficients of 1.36 and 136 cal $\cdot$ $sec^{-1} \cdot m^{-2} \cdot °C^{-1}$. Values of heat transfer on the order of 5 cal $\cdot$ $sec^{-1} \cdot m^{-1}$ can be obtained. Calculations indicate that in order to apply this technique for the utilization of significant portions of reject heat, the system must be viewed in terms of an agricultural power plant complex encompassing large quantities of land. (auth)

26869 ECONOMIC ANALYSIS OF SELECTED AGRICULTURAL USES OF WARM WATER IN THE PACIFIC NORTHWEST RESULTING FROM ELECTRIC POWER GENERATION. Johns, R. W.; Folwell, R. J.; Dailey, R. T.; Wirth, M. E. (Washington State Univ., Pullman). J. Environ. Qual.; 2: No. 2, 224-228(1973).

From symposium on beneficial uses for thermal discharges; New York (19 Aug 1971).

Between 1970 and 1990, 85% of all new electric power generating capacity is estimated to require water for cooling. This poses a question for research scientists from several disciplines of finding some productive use for the waste water required by steam generating plants. Since there is usually a finite amount of water available for cooling purposes adjacent to the plant sites, the problem becomes one of finding an economic use for a scarce resource. Several possibilities are discussed for making use of waste water: aquaculture, soil heating, and greenhouse heating. Two alternatives were considered for using cooling reservoirs the production of carp for feed or fish meal, and catfish for the fresh market. Soil warming and greenhouse heating would involve locational problems relative to plant production, processing facilities, and transportation. None of the uses studied showed clear-cut advantages in terms of profits which would attract economic investment. The price of carp must be greater than $59.52/metric ton to pay for the rental costs; the current market price ranges from $55 to $60/metric ton. The market demand for catfish has been overestimated and prices have been declining for the past 5 years. Using a 607-hectare (1,500-acre) cooling pond, the market price for catfish would have to be $.44/kg ($.20/lb) or the enterprise would not pay for the use of the facilities. Catfish prices for 1970-71 were $.57/kg ($.26/lb); further increases in production in the southern USA will likely cause even lower prices. Relocating greenhouses in order to use warm water for heating appears to be a marginal investment. The size of soil-warming systems is limited by the high initial investment, estimated yield response, and vegetable prices. A soil-warming technique costing only $4,942/hectare ($2,000/acre) to install would be profitable for 20 or 29 vegetable crops considered; an investment cost of $12,355/hectare ($5,000/acre) would be profitable for only 1 of the 29 crops considered. (auth)

26870 INTEGRATED SYSTEMS FOR UTILIZING WASTE HEAT FROM STEAM ELECTRIC PLANTS. Boersma, L.; Rykbost, K. A. (Oregon State Univ., Corvallis). J. Environ. Qual.; 2: No. 2, 179-187(1973).

From symposium on beneficial uses for thermal discharges; New York (19 Aug 1971).

Multiple use of waste heat and cooling waters from power plants will become an important consideration in the development, siting, and certification of these plants. The heat in the cooling water must be considered a resource to be managed for effective use. At the same time, society faces problems of degradation of its environment caused by industries, by individuals, and by communities. Pollution problems such as disposal of agricultural and domestic sewage, calefaction, and use of persistent chemicals must be solved in concert, not individually. The ultimate solution to these problems must be found in the development of integrated systems in which resources are not used in a destructive manner but are recycled. These observations prompted the development of a system of components that can beneficially utilize waste heat, allow multiple use of the cooling water, and achieve a high degree of efficiency in the production of food and fiber without causing polluted streams and soils. The concept fits anticipated trends in agriculture where a higher rate of production per unit area must be achieved for economic reasons and to avoid some of the ecological impact. It allows wise land-use planning which is rapidly emerging as a major national issue. A statement of the problem is presented, the magnitude of the present and future rate of waste heat production is considered, and criteria for the use of waste heat are introduced. Certain aspects of the feasibility of the proposed integrated systems are evaluated. (auth)

26871 HEAT TRANSFER MODELS FOR A SUBSURFACE, WATER PIPE, SOIL-WARMING SYSTEM. Kendrick, J. H.; Havens, J. A. (Univ. of Arkansas, Fayetteville). J. Environ. Qual.; 2: No. 2, 188-196(1973).

From symposium on beneficial uses for thermal discharges; New York (19 Aug 1971).

Mathematical models are developed for the prediction of heat losses from subsurface pipes carrying hot water. The method of images is used to calculate the heat loss from a hot water pipe buried at a given depth below the surface of a homogeneous soil with a constant soil surface temperature. The heat loss is described as a function of the difference between the temperature of the water and the temperature of the soil surface. The energy balance is used to determine the longitudinal temperature distribution of the water. The method is extended to describe the heat loss and the longitudinal temperature distribution for a system of equally spaced, parallel, subsurface pipes with water flowing in the same direction in neighboring pipes. Finally, the method is extended to calculate the heat loss and the longitudinal temperature distribution for a system of equally spaced, parallel, subsurface pipes with water flowing in opposite directions in neighboring pipes. Soil temperature profiles around the buried pipes are presented. The models are used to calculate the land area which can be heated with an underground piping system carrying the cooling water from the condensers of a 1000-megawatt nuclear-powered steam generation electric power plant. (auth)

26872 ECOLOGICAL MANAGEMENT OF THERMAL DISCHARGES. Oswald, W. J. (Univ. of California, Berkeley). J. Environ. Qual.; 2: No. 2, 203-207(1973).

From symposium on beneficial uses for thermal discharges; New York (19 Aug 1971).

Heat from thermal discharges may improve sewage, animal and vegetable waste treatment processes. With sufficient heat, human, animal, and vegetable wastes may be subject to methane fermentation and algal growth the year around. Algae produced on human and animal waste may be used for livestock feed. The algae produced on vegetable wastes may be processed for human food. Following algae production, the waste water is hygienic and suitable for parks. The rate of anaerobic fermentation in ponds increases 30-fold between 15 and 35°C. The most promising algae, Scenedesmus quadricauda, grows best at 20°C. Waste decomposition and protein production rates exceed 100 times those normally found in nature. Algae ponds gain and lose heat at rates exceeding those found in ponds free of algae. Calcium and magnesium removal in algal ponds reaches 50% of influent. Intensive research on such integrated systems is recommended. (auth)

26873 HEAT BUDGET OF COOLING BASINS. Lindstrom, F. T.; Boersma, L. (Oregon State Univ., Corvallis). J. Environ. Qual.; 2: No. 2, 197-202(1973).

From symposium on beneficial uses for thermal discharges; New York (19 Aug 1971).

A system of open water basins which allows beneficial use of heated discharges from thermal power stations while at the same time providing a heatsink is proposed. These are large, shallow compartments filled with water which is well mixed, while cooling water is pumped through conduits below the basins. They might be used for the production of single-cell protein and fish. Equations were derived for the temperature distribution in the warm water conduit and basins of the system used in conjunction with a 1000-megawatt electric power plant. The rate of heat loss is controlled by the rate of heat loss at the air–water interface which may vary widely as a function of windspeed and relative humidity. The rate of heat exchange between the basins and the conduits was not critical. The surface area of basins required may vary from about 100 hectare to over 500 hectare. For a constant surface area of the basins the temperature of the cooling water would fluctuate as a result of changing rates of heat loss. It might be difficult to develop commercial uses for a large number of basins. Use of such basins in conjunction with other methods of heat dispersion is therefore suggested. (auth)

26874 SIMULATION MODEL TO STUDY THE UTILIZATION OF WASTE HEAT USING A COMBINATION MULTIPLE RESERVOIR AND GREENHOUSE COMPLEX. Price, D. R.; Peart, R. M. (Purdue Univ., Lafayette, IN). J. Environ. Qual.; 2: No. 2, 216-224(1973).

A system designed to utilize waste heat discharged by the cooling condenser of a steam-electric generating station is investigated using system analysis techniques. Much of the analysis is carried out with the assistance of computer simulation of the total system. The system under study involves the use of multiple reservoirs for storage, utilization, and dissipation of the thermal discharge from a 1000-megawatt generating station. One reservoir is used for storage of the warmest water to be used for heating of a greenhouse located adjacent to the reservoir. A second reservoir is included and used for commercial fish production, while another is used for recreational purposes and provides the necessary cooling capacity for summer cooling. Mathematical models are developed to describe the heat exchange characteristics of the reservoirs and greenhouse. A descriptive model is added to describe and define the detailed operating conditions of the total system. These models are incorporated into a computer simulation model which is used in the analysis. The study includes an investigation of simulation languages available for simulation of large scale systems. The special purpose language, DYNAMO, is selected and used for the simulation tests. The development and coding of the computer program are discussed in detail. Sensitivity analysis is used to study the behavior of the system with variations in the design and operation. Operating ranges are determined for the various components of the system. The simulator is used to study the operation of the system throughout a 1-year simulation period. The simulation model uses actual weather data in the computations to determine heat exchange within the reservoirs and the greenhouse. A study of the effect of the level of aggregation of the weather data is included. The computer simulator is used as a tool for developing a control system to automatically control the real world system. A description of the control system including a circuit design is included. The simulator is used to show that a 2,500-acre recreational lake, up to 500 acres of reservoir for fish production, and up to 350 acres of greenhouse make up a feasible system design. (auth)

26875 DISSIPATION OF EXCESS HEAT FROM WATER SYSTEMS. Jobson, H. E. (Geological Survey, Bay St. Louis, MS). J. Power Div., Amer. Soc. Civil Eng.; 99: No. PO1, 89-103(May 1973).

A model for the prediction of excess temperature is shown to have the form of the classical diffusion equation. The excess temperature in this model is defined as the difference between the actual water temperature and the water temperature that would have occurred provided that a particular heat source, such as a power plant, had never existed. This definition of excess temperature is convenient because it directly represents the incremental effect that a heat source has on a water system and, provided that historical water temperature records are available, the excess temperature can be predicted without the use of solar or atmospheric radiation data. A prediction equation for the surface transfer coefficient for excess heat illustrates that this coefficient is primarily dependent upon the water temperature and wind speed, and that it is almost independent of the humidity and temperature of the air. (auth)

Chemical Effluents

Refer also to abstracts 26934, 28775, 28821, 28885, 28898, 28899, 28906, and 28958.

26876 (ORNL-4935, pp 66-73) TOXIC MATERIALS IN THE ENVIRONMENT. Van Hook, R. I.; Allen, C. P.; Anderson, S. H. Mar 1974.

In Environmental Sciences Division annual progress report for period ending September 30, 1973.

The Toxic Materials in the Environment project is concerned primarily with sources, cycling, and fate of trace elements in aquatic and terrestrial ecosystems. This project is currently addressing three major research areas: trace elements in soils and sediments, biological transport of trace elements, and environmental reconnaissance and cycling. Results to date are summarized on characterization of cadmium and nickel in river sediments; evaluation of organic matter and sequioxides of iron and aluminum on the absorption of trace elements by clay minerals; the effects of the environmental factors, temperature, and concentration on the accumulation of methylmercury by fish populations; and the establishment of forest stand and input/output budgets of cadmium, lead, zinc, and several other trace elements for Walker Branch Watershed. (auth)

26877 (ORNL-4935, pp 74-84) WALKER BRANCH WATERSHED: A STUDY OF TERRESTRIAL AND AQUATIC SYSTEM INTERACTION. Henderson, G. S.; Anderson, R. M.; Anderson, S. H. Mar 1974.

In Environmental Sciences Division annual progress report for period ending September 30, 1973.

Retention and transport of elements and materials in forested landscapes are being investigated in the Walker Branch Watershed project in order to better understand ecosystem function and assess the impact of controlled and accidental releases of elements to similar ecosystems. The project emphasizes interactions between the terrestrial and aquatic components of the watershed ecosystem and therefore concentrates research on the two dominant element carrier systems, water and biomass. Less than 5% of the total amount of elements cycling within a forest is lost to streams through water movement. A dominant mechanism for preventing greater loss of elements has been shown to be the dynamics of root death and decomposition, with microbial immobilization and subsequent plant uptake during new root growth. Precipitation which produces large increases in streamflow has been shown to be of overriding importance in the annual transport of water and elements from the landscape. Approximately 20% of the annual water loss on Walker Branch Watershed occurs during the week of peak annual discharge. Element concentrations in streamflow change during these storm periods according to the mobilities of elements, but transport in both dissolved and suspended form increases. The movement of suspended organic and inorganic material, which predominates at high discharge rates, accounts for the major transport to aquatic systems of many trace elements which are generally present in very low concentrations in dissolved form. Application of results from this watershed study was used to evaluate economic and environmental considerations associated with land disposal of nitrate-rich industrial effluents, using extant data from the Walker Branch project to provide less critical variables needed for construction of mathematical simulation models. These models predicted ecosystem stability and longevity before detrimental effects would be incurred due to effluent nitrate additions, and thus provided the basis for cost-benefit analysis of this disposal practice. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 27382 and 28138.

General Detectors and Monitors

Refer also to abstracts 27130, 27165, and 28665.

26878 (AD-766303-2) ANALYTICAL MODEL OF THE FERROELECTRIC RADIATION DETECTOR. Klopcic, J. T.; Swanson, D. L. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Jul 1973. 21p. (BRL-MR-2310). NTIS $2.75.

As part of the Defense Nuclear Agency project J11 AAXPX231 to study the behavior of the ferroelectric radiation detector, an analytical model of the energy balance within a ferroelectric crystal has been developed. This model relates ionic spacing and charges to macroscopic quantities such as the pyroelectric and piezoelectric coefficients. Although a highly simplified model, resulting in calculations that can be handled by a desk top calculator, it accurately predicts those quantities of interest in analyzing normal ferroelectric radiation detector response. Because the model also accounts remarkably well for certain piezoelectric parameters, it appears that application may be extended to ferroelectric transducers and components other than radiation detectors. (auth)

26879 (ANL-CT-74-45824-1) TEST OF THE HIGH TEMPERATURE NUCLEAR DETECTOR CABLE END-SEAL TEST FACILITY TO 1200°F. Cassidy, C. J. (Argonne National Lab., Ill. (USA)). 4 Feb 1974. 17p. AT.

Test results and a list of test instrumentation and equipment for the end-seal test facility are presented. The test facility is now ready for use in the testing of end seals to 1200°F. (WHK)

26880 (CERN-74-5) MACHINE TO WIND ULTRAFINE METALLIC WIRES USED IN THE FABRICATION OF SMALL-DIMENSION WIRE CHAMBERS. Benoit, R. E. (European Organization for Nuclear Research, Geneva (Switzerland)). 4 Mar 1974. 10p. (In French). Dep. NTIS (U. S. Sales Only) $4.00.

A machine to weave ultrafine wires with a diameter of the order of 2 to 5 μ is described. It has the possibility of several spacings equal to the smallest wire. Welding of the wires can be done on the machine itself. (tr-auth)

26881 (COO-3182-1) REGIONAL BLOOD FLOW IN SUBCORTICAL STRUCTURES IN MAN. Final Report. Sem-Jacobsen, C. W. (Gaustad Sykehus, Oslo (Norway). EEG Research Lab.). 1973. Contract AT(11-1)-3182. 33p. Dep. NTIS $3.75.

Beta sensitive beads to be implanted in the human brain using the depth-electrographic technique were developed for use for continuous monitoring of the blood flow following radionuclide administration. The tissue reaction around the sensors was negligible. The sensors have sufficient sensitivity for monitoring ^{85}Kr following injection into arteries or inhalation in air. A suitable amplifier and a computer program for the handling of data were developed. (CH)

26882 (DESY-73-54) MEDEA, A SPECIAL COMPUTER FOR HANDLING AND FORMATTING DATA FROM PROPORTIONAL CHAMBERS. Stuckenberg, H. J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Nov 1973. 17p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

MEDEA is a special computer for handling and formatting data from proportional chambers. It converts incoming data from a bit-to-address-readout system into binary addresses. A built-in RePROM contains the number of counting wires per chamber plane used during the experiment. The address of the last wire of plane (n-1) will be subtracted from the address under surveillance in plane n; this address is the wire number in plane n; it is compared with the address of the previous operation for checking whether it is a single or a cluster address. The binary address is then added to the cluster length divided by two to obtain the center address of a cluster. The result is loaded into a buffer memory, from where it will be transmitted to a PDP-11 computer. (auth)

26883 (FRNC-TH-446) STUDY AND DEVELOPMENT OF A LARGE MULTIWIRE PROPORTIONAL CHAMBER. Amplifier and Reading Logic. Schaub, G. (Strasbourg-1 Univ., 67 (France)). 1973. 97p. (In French). Dep. NTIS (U. S. Sales Only) $8.00.

Thesis.

A large prototype multiwire proportional chamber was constructed. The theory of these detectors is exposed together with the conditions imposed on the geometry of the chambers. The problems encountered in the development of the prototype are presented together with the solutions obtained. A description is given of the different elements of the signal receiving electronics, amplifier, and shaping circuit together with that of the verifying logic and event memory. Two other similar sized chambers were also fabricated. These chambers differ from the prototype in which the wires are hand positioned and soldered; a special automatic machine at CERN being used to weave the wires. The detection efficiency problem was overcome by fixing the distance between the wires (2.5 mm) and by providing the gas feed system with an accurate flow rate regulator for each gas thus ensuring a control of the freon concentration. This factor is extremely critical. A detection efficiency of greater than 93% was reached immediately after putting gas into the new chambers, no special adjustments being made to the electronics. After all the adjustments had been made, the efficiency was 98%. (FR)

26884 (INIS-mf-952) FILTERING OF SIGNALS OBTAINED FROM SEMICONDUCTOR RADIATION DETECTORS. Koeman, H. (Katholieke Universiteit Nijmegen (Netherlands)). 16 Mar 1973. 132p. INIS.

The desired and observed properties of filter networks that are applied in nuclear radiation spectrometers in which a semiconductor detector is present as a pick-up device are discussed. First, important factors affecting the filter properties are discussed. Then, emphasis is placed on an x-ray spectrometry application where a realized filter network is used. The most important qualities which were tested and compared for a theoretically derived, a conventional time-invariant analogue, a recently developed time-invariant analogue and a time-variant transversal digital filter, are the signal-to-noise ratio and the number of signals per time unit that can be measured without being disturbed by other signals. Most signal-to-noise ratio calculations are done in the time domain using the filter response function for obtaining direct insight into both the expected signal-to-noise ratio and the time needed for the undisturbed measurement of one signal. The contribution of the noise source with 1/f power density function is always calculated separately; its dominating effect over the other noise sources is remarkable. The special type of transversal digital filter is unique in the nuclear electronics field; its operation is described extensively. Theoretically derived properties of this filter are compared with those of the remaining filter types hitherto known. The measured signal-to-noise ratio using the digital filter for the ^{55}Fe x-ray spectral line at 5.9 keV as a function of the radiation intensity contrasts favorably with the properties measured in practice from all other types of filtering methods mentioned in the literature. (INIS)

26885 (UCRL-51528) SCINTILLATION RESPONSE OF LITHIUM FLUORIDE. Kloepping, R. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Feb 1974. Contract W-7405-eng-48. 123p. Dep. NTIS $9.25.

Thesis.

Lithium fluoride crystals, with TlF added to the charge, were prepared by the Bridgman–Stockbarger method. The scintillation response to photon energies between 25 and 1250 keV for these crystals and a commercially prepared LiF (Ti) crystal was studied. The response of the LiF (Ti) crystal was compared to the response of an NE109 scintillator at 1250 keV. The dose response of the LiF (Ti) crystal was evaluated over the energy range 25 to 1250 keV. The absorption and emission spectra of the LiF (Ti) crystal are discussed. A historical review precedes the discussion. (auth)

26886 QUENCHING GAS FOR DETECTORS OF CHARGED PARTICLES. Atac, M. (to United States Atomic Energy Commission). US Patent 3,787,746. 22 Jan 1974. Filed date 11 May 1973. 6p.

Operation of detectors of charged particles such as wire counters and Geiger–Muller tubes is improved by filling the counters with a quenching-gas mixture of argon, isobutane and methylchloroform. (Official Gazette)

26887 MEASUREMENT OF IONIZING RADIATION. Fosmark, H.; Johansen, J.; Klokk, A.; Strickert, T.; Aamlid, H. (Statens

Institutt for Straalenhygiene, Oslo). pp 90-101 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

The principles and construction of ionization chambers, G.M. tubes, proportional counters, and scintillation counters are briefly described. The principle of semiconductor detectors is also treated briefly. The techniques of thermoluminescence dosimetry, calorimetry, chemical dosimetry and film dosimetry are described. (NO)

26888 STRUCTURE AND FUNCTION OF A MEDICAL MEASURING SYSTEM FOR WOUNDS. Ohlenschlaeger, L.; Frombein, O. (Kernforschungszentrum, Karlsruhe, Ger.). Strahlentherapie; 146: No. 4, 422-432(Oct 1973). (In German).

Operational and technical features of a measuring system for the determination of radionuclides, particularly ^{239}Pu, in contaminated wounds are described. Special consideration is given to the integration of different detectors and devices into a mobile and portable measuring unit with central control. Experimental results give proof of the system performance. (GE)

26889 PROPORTIONAL COUNTER RADIATION CAMERA. Borkowski, C. J.; Kopp, M. K. (to United States Atomic Energy Commission). US Patent 3,786,270. 15 Jan 1974. Filed date 1 Feb 1973. 12p.

A gas-filled proportional counter camera that images photon emitting sources is described. A two-dimensional, position-sensitive proportional multiwire counter is provided as the detector. The counter consists of a high-voltage anode screen sandwiched between orthogonally disposed planar arrays of multiple parallel strung, resistively coupled cathode wires. Two terminals from each of the cathode arrays are connected to separate timing circuitry to obtain separate X and Y coordinate signal values from pulse shape measurements to define the position of an event within the counter arrays which may be recorded by various means for data display. The counter is further provided with a linear drift field which effectively enlarges the active gas volume of the counter and constrains the recoil electrons produced from ionizing radiation entering the counter to drift perpendicularly toward the planar detection arrays. A collimator is interposed between a subject to be imaged and the counter to transmit only the radiation from the subject which has a perpendicular trajectory with respect to the planar cathode arrays of the detector. (Official Gazette)

26890 METHOD AND APPARATUS FOR SENSING RADIATION AND PROVIDING ELECTRICAL READOUT. Eichelberger, C. W. (to General Electric Co.). US Patent 3,795,806. Mar 1974. Filed date 2 Mar 1973. 14p.

A plurality of radiation sensing and storage sites are provided on a substrate of semiconductor material arranged in a plurality of rows and columns. Each site includes a row oriented plate and a column oriented plate to form a pair of closely coupled capacitive cells with the substrate. A plurality of row conductor lines are provided, each connected to the row oriented plates of a respective row. A plurality of column conductor lines are also provided, each connected to the column oriented plates of a respective column. In operation, application of appropriate voltages to the capacitive cells forms depletion regions therein with charge permitted to flow between closely coupled cells depending on the voltage on the plates thereof. Selective read out of charge stored in a row of sites is accomplished by changing the potential on the row line to cause charge stored in the row-oriented cells to flow into the column-oriented storage cells thereof. The read out of charge stored in the column-oriented cells is accomplished by changing the potential on each of the column lines in turn to cause injection of carriers stored therein into the substrate and sensed across an integrating capacitor. Reestablishment of depletion producing potentials on the column-oriented plates causes previously injected carriers which have not had time to recombine or diffuse sufficiently far away to be recollected. Such recollected charge is periodically injected at the end of a row of scan, when the depletion regions of the row oriented plates have been collapsed, by collapsing the depletion regions underlying all of the column oriented plates for a time sufficient to assure complete disappearance of injected carriers from the regions of storage thereof. (Official Gazette)

26891 CELLULOSE NITRATE AS AN ALPHA PARTICLE DETECTOR. Umarov, G. Ya.; Abdullaev, D.; Murtazaev, Kh. (Tashkent State Univ.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 5, 72-73(1973). (In Russian).

The appearance of α tracks in cellulose nitrate irradiated with α particles from ^{210}Po at an energy of 5.3 MeV is studied at different concentrations of NaOH, temperatures, and etching times. Optimum conditions for development of the α tracks are determined. Under these conditions cellulose nitrate can be used for activation analysis and the study of (n,α) and (γ,α) reactions. (JSR)

26892 SOLID TRACK DETECTORS FOR α PARTICLES. Bonczak, Z.; Natanson, L. (Univ., Lodz, Poland). Nukleonika; 18: No. 12, 577-583(1973).

Some properties of the Kodak Special Film LR 115 were investigated. Counting efficiency for α particles in the energy range from 1.40 MeV to 3.78 MeV was measured as well as the sensitivity to 14.6-MeV neutrons, reactor neutrons, and bremsstrahlung from 31 MeV electrons. The dependence of the diameter of the track of an α particle on its energy was determined. Examples of α particle spectra obtained with the film are shown. (auth)

26893 TELESCOPIC SYSTEM FOR THE STUDY OF (n,α) REACTIONS INDUCED BY FAST NEUTRONS. Burzynski, S.; Smolec, W.; Turkiewicz, I. M.; Turkiewicz, J.; Zupranski, P.; Rusek, K. (Inst. of Nuclear Research, Warsaw). Nukleonika; 18: No. 12, 603-607(1973).

A telescopic system consisting of two gas proportional counters followed by a silicon surface barrier detector is described. Preliminary results obtained with the system in the study of the $^{9}Be(n,\alpha)^{6}He$ reaction at 14 MeV neutron energy are also presented. (auth)

26894 INFLUENCE OF THE IRRADIATION BY HIGH DOSE γ RAYS ON THE REGISTRATION EFFICIENCY OF SOLID TRACK DETECTORS. Nicolae, M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 9, 1131-1138(1973).

A systematic study was performed on the influence of the high dose γ radiation on the kinetics of etching and the registration threshold of some plastic track detectors, like cellulose nitrate, polycarbonate and polyethyleneterephthalate. An important acceleration of the etching was observed at an absorbed dose above 10^{6} rad, especially for the plastics which exhibit a long period of etching, like polycarbonate and polyethyleneterephthalate. In this last case, an increase of the recorded track length of the heavy ions was also observed on the irradiated plastics. (auth)

26895 USE OF SOLID PARTICLE DETECTORS IN THE STUDY OF THE RADIOACTIVE DISEQUILIBRIUM OF URANIUM ORES. Chantret, F. (CEA, Chatillon, France). Bull. Soc. Fr. Miner. Crist.; 96: No. 3, 223-224(May 1973). (In French).

A core sample obtained from a borehole in a uraniferous sandstone was studied. The sample was investigated using α autoradiography and the fission track technique. Comparisons made between the two images demonstrate that the α emission is due to uranium daughter products (radium). (FR)

26896 NEW ROLE OF SCINTIGRAPHS IN WHOLE-BODY COUNTING TECHNIQUES. Chomicki, O. A. (Centrum Medycznego Kaztalcenia Podyplomowego, Warsaw). Postepy Fiz. Med.; 7: 189-195(1972). (In Polish).

A review is given of the parallel development of clinical whole-body counting and scintigraphy, the latter having followed the exponential law. The present trend seems to be for whole-body counting to incorporate to a much greater extent the localized measurements and, therefore, overlap the whole-body rectilinear scanning methods. At the same time, new high-sensitivity commercial scanners can be used as whole-body counters because of the use of large 5-in.-dia. × 3-in.-thick NaI(Tl) crystals. By adding inexpensive shielding (a collimator or a low-background room), activities of the order of nanocuries can be measured. A low-cost whole-body scanner-type installation seems to be particularly appropriate in places where the high cost of whole-body counters prevents them from being used on a larger scale. (auth)

26897 MATHEMATICAL MODEL TO ANALYZE THE DAMAGE PROFILE ALONG FAST ION TRACKS AND EXPERIMENTAL INVESTIGATIONS CONCERNING CORROSIVE ACTION OF PARTICLE TRACKS IN POLYMERS. Leuthold, G. Munich; Technische Univ. Munich ([ndl]). 48p. (In German).

Thesis.

With a collision spectrum more realistic in comparison to the classical model, the stochastic energy losses of ion-passage through polymers is calculated with the help of the Monte Carlo method. The mean distance for excitation and ionization for different ions is given. The calculations are used to interpret the etching behavior of α-particle tracks in cellulose triacetate and an explanation of the observed detection limit is given. (GE)

26898 IMAGE PROFILES OF A RADIOACTIVE HOMOGENEOUS SOURCE AS A MEASURE OF SCINTOGRAM DISTORTION OF GAMMA CAMERAS. Gwiazdowska, B.; Mackiewicz, H.; Tol-

winski, J.; Siwicki, H. (Inst. of Oncology, Warsaw). Postepy Fiz. Med.; 7: 225-233(1972). (In Polish).

The work was done for the purpose of distortion investigation in the impulse quantity being recorded by a scintillation camera (Pho/Gamma III). It is confirmed that the difference between the maximum and the minimum deviation from the average of the measured impulses (for detector diameter not suffering the edge effect) amounts to about 25% as well for ^{99m}Tc as for "mock-iodine". (auth)

Radiation Dosimeters

Refer also to abstract 28623.

26899 (AD-767044-1-GA) DOSIMETRY FOR THE AURORA FACILITY. Final Report. Attix, F. H. (Naval Research Lab., Washington, D. C. (USA)). Mar 1973. 51p. (NRL-MR-2552 (Rev.)). NTIS $3.50.

A suitable thermoluminescent dosimeter system has been recommended and adopted for routine use at the Aurora Facility: The 0.4-mm × 6-mm 5% CaF_2 : Mn in Teflon disc dosimeters are used in conjunction with the Harshaw Model 2000 TLD Reader. A spherical silicon calorimeter has been designed, constructed, tested, and put into service as a dose standard at the Aurora Facility. After operating successfully for dozens of shots, it began showing signs of possible radiation damage about one million rad. Recalibration of the thermistor revealed an 11% increase in resistance over the entire temperature range 15 to 35°C. The calorimeter is back in service, employing the new calibration. Attenuation measurements at the Aurora Facility have indicated that the bremsstrahlung near the rear of the test volume (100 cm from the wall) has an effective energy of about 1.4 MeV. (auth)

26900 (CEA-CONF-2540) DOSIMETRY OF COSMIC RADIATION ON BOARD THE SUPERSONIC TRANSPORT CONCORDE. Francois, H.; Delahaye, R. P.; Simon, P.; Portal, G.; Kaiser, H.; Durney, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service Technique d'Etudes de Protection et de Pollution Atmospherique). [nd]. 12p. (In French). (CONF-730907-2i). Dep. NTIS (U.S. Sales Only) $3.00.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

Dosimetry of cosmic radiation on-board the French prototype supersonic transport Concorde 001 performed during the aircraft's test flights included the use of nuclear emulsions in which each event is individually analyzed; stacks of nuclear emulsions of varying sensitivity which permit obtaining ionizing-particle distribution as a function of their TEL; thermoluminescent dosimeters; fast-neutron dosimeters; and dose-rate recording systems. The results obtained are reported and the dosimetric problems posed by possible solar flares, and their effects upon flight plans are discussed. Conclusions are drawn relative to the possible dosimetry techniques to be employed in identifying radiation protection problems on-board the SST. (auth)

26901 (COO-1105-187) RESPONSE OF LiF THERMOLUMINESCENCE TO LOW ENERGY β-RAYS FROM TRITIUM. Lasky, J. B.; Wagner, J.; Pearson, D.; Moran, P. R.; Cameron, J. R. (Wisconsin Univ., Madison (USA). Dept. of Physics). 1971. 8p. Dep. NTIS $4.00.

The thermoluminescence glow curves from LiF samples exposed to low energy β-rays from tritium are distinctly different from the glow curves one normally sees after exposure to x-rays or high energy β-rays. The sensitivity of LiF samples for tritium β's is discussed. This phenomenon could be applied to environmental radiation monitoring since the distinctive tritium β glow curve allows an estimate of the dose from tritium in a mixed radiation environment. (auth)

26902 (FRNC-TH-414) THEORETICAL AND EXPERIMENTAL STUDY OF THE REDUCTION IN SENSITIVITY OF A MULTISPHERE SYSTEM HAVING AN EPITHERMAL DETECTOR USED FOR FAST NEUTRON RADIOPROTECTION. Kobeissi, M. (Grenoble-1 Univ., 38 (France)). 1973. 101p. (In French). Dep. NTIS (U. S. Sales Only) $8.25.

Thesis.

In an attempt to improve the multisphere technique, the problem of measuring the sensitivity losses of a ^{6}LiI crystal used at the center of the sphere and subsequently enclosed in Cd (which detects only epithermal neutrons) is considered. A theoretical analysis is presented on the interaction between a fast neutron beam (14 MeV) in polyethylene spheres containing a ^{6}LiI crystal at their centers. The different phenomena occurring from the time of the initial shock up to thermalization were studied in order to determine the effect of the variations in the diameter of the sphere and in the size of the ^{6}LiI crystal. A mixed method of simulation was employed, this method simultaneously involving a transport code adapted to the problem and a Monte-Carlo method. In the case of a 15 inch sphere, the Monte-Carlo method yielded the source term, a sufficient number of results being obtained. Multigroup analytical calculations permitted the slowing-down flux in the sphere to be determined in a particular energy range and a classical geometry, together with the reaction rate of ^{6}Li(n,α) reactions for all energies, account being taken of the self absorption correction for the case of thermal neutrons. In this way a drop in sensitivity of 91.6% was deduced, this value lies well within the observed experimental uncertainties. (FR)

26903 THERMALLY STIMULATED EXOELECTRON DOSE METER FOR HEALTH PHYSICS MEASUREMENTS. Boros, L. (Orvos-Radiological Akademiai Tanszeki Kutatocsoport, Budapest). Izotoptechnika; 17: No. 1, 15-23(Jan 1974). (In Hungarian).

The parameters of the TSEE BeO : Li dosimeter were studied: lower limit of measurement range 1 μrad; sensitivity in a range of 5 magnitudes proportional to dose; and energy and directional dependence. Fading at room temperature was negligible; and the reproducibility is ±6%. (auth)

26904 WORKING STANDARD OF THE UNIT OF INTENSITY OF EXPOSED DOSE OF GAMMA RADIATION OVER THE RANGE 3nA/kg TO 3pA/kg((APPROX. 10-0.1 μR/sec). Tuchin, V. N.; Yudin, M. F. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 8, 1225-1227(Aug 1973).

Translated from Izmer. Tekh.; 16: No. 8, 68-70(Aug 1973).

The design and performance of a lead-shielded NaI(Tl) scintillation gamma spectrometer for measuring low-intensity gamma spectra and subsequent conversion to exposed dose are discussed. Spectrometer calibration, efficiency, and errors are discussed and the method for converting the gamma spectra to dose is described. (WHK)

26905 ERROR OF A SEPARATE DETERMINATION OF THE ABSORBED DOSE OF NEUTRONS AND GAMMA RADIATION WITH IONIZATION CHAMBERS. Bregadze, Yu. I.; Maslyaev, P. F. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 8, 1228-1229(Aug 1973).

Translated from Izmer. Tekh.; 16: No. 8, 70(Aug 1973).

Errors encountered in using two ionization chambers with different hydrogen contents in the walls and gas filling for simultaneous measurement of the absorbed dose of neutrons and gamma radiation in materials are discussed. (WHK)

26906 GAS PHASE DOSIMETRY BASED ON NITROGEN YIELD FROM NITROUS OXIDE. McLaren, K. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Int. J. Appl. Radiat. Isotop.; 25: No. 2, 87-93(Feb 1974).

Gas phase radiation dosimetry based on nitrogen yield ($G(N_2)$) from nitrous oxide was studied. Comparison of yields obtained on an absolute basis (ionization current dosimetry) by various workers using optimum experimental conditions (N_2O pressure 500 to 760 mm Hg, total doses < 1.2×10^{20} eVg^{-1}; irradiation temperature 20 to 30°C) shows poor reproducibility for the N_2O dosimeter system. In this work $G(N_2)$ was found to be 9.03 ± 0.10 (standard error −33 measurements) for γ irradiation at dose rates of about 6×10^{13} eV cm^{-3} mm Hg^{-1} hr^{-1}, and 8.59 ± 0.23 (standard error −9 measurements) for 1 MeV electron irradiation at dose rates around 2×10^{15} eV cm^{-3} mm Hg^{-1} hr^{-1}. The difference in the mean $G(N_2)$ values for γ and electron radiolyses is not statistically significant at the 99% confidence level. The accuracy of the ionization dosimetry method was checked by measuring $G(H_2)$ and $G(CH_4)$ yields from ethylene, which agreed well with values found in the literature. Nitrogen yields are lower than those of other workers, and experimental errors which could give spuriously high $G(N_2)$ values are discussed. It is shown that the reproducibility of the ethylene dosimeter is superior to that of the nitrous oxide dosimeter. (auth)

26907 HIGH RADIATION DOSE LUMINESCENT AND OPTICAL DOSIMETRY SYSTEMS. Lambert, K. P.; Van de Voode, M. (European Organization for Nuclear Research, Geneva). Int. J. Appl. Radiat. Isotop.; 25: No. 2, 69-79(Feb 1974).

An investigation of the characteristics of radiophotoluminescent, thermoluminescent and optical absorption dosimeters has indicated that they are suitable for use as radiation damage dosimeters in high energy particle accelerators. An introduction is given to their respective modes of operation and to their integration into a practical dosimetry system. (auth)

26908 AUTOMATIC EXPLOITATION OF PHOTOGRAPHIC DOSIMETERS. Fiegel, A. (Laboratoire Central de l'Armement,

Arcueil, France). Radioprotection; 8: No. 2, 85-95(1973). (In French).

The problems encountered in the automatic reading of photographic dosimeters are recalled. The method adopted is described and the results obtained illustrated using examples to test its validity and that of the corresponding computer program. (FR)

26909 RADIATION DOSEMETERS OF THE THERMOLUMINESCENT TYPE. Brunskill, R. T.; Langmead, W. A. (to United Kingdom Atomic Energy Authority). US Patent 3,790,783. 5 Feb 1974. Priority date 6 Nov 1970, United Kingdom of Great Britain and Northern Ireland. 2p.

A radiation dosemeter comprising thermoluminescent powder mounted on a base of graphite or other material which can be heated by radiofrequency is described. (2 claims, 1 drawing figure) (Official Gazette)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 28272.

26910 (EUR-5070) UNFOLDING OF COMPOSITE SPECTRA BY LINEAR REGRESSION. Matthes, W. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). 1974. 22p. Dep. NTIS (U. S. Sales Only) $4.25. EUR B. Fr. 50.

The problem of resolving a measured pulse-height spectrum of a material mixture (e.g., Raman-spectrum, gamma-spectrum) into a weighted sum of the spectra of the individual components of the mixture was studied. If the measured spectrum is contaminated with noise, the standard least-square method cannot be used to unfold the spectrum into its individual components for small signal-to-noise ratios. To improve the identification of the components in the mixture a "stepwise regression" method was constructed which gives very good results even for signal-to-noise ratios of the order of one. The new method is a combination of the least-square mechanism and repeated application of statistical tests. (auth)

26911 (JINR-P13-7755) MULTIWIRE PROPORTIONAL CHAMBER FOR ALPHA-SPECTROGRAPH. Biryukov, V. A.; Vakhtel, V. M.; Golovkov, N. A.; Zinov, V. G.; Konin, A. D.; Ormandzhiev, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab of Nuclear Problems). 1974. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

A multiwire proportional chamber with the analog type of information readout is described. The chamber is designed for automatized spectra measurements in a big α-spectrograph of the Joint Institute for Nuclear Research. (auth)

26912 (SGAE-2193) APPLICATION OF FOURIER TRANSFORM IN GAMMA-SPECTRA EVALUATION. Blinowska, K. J.; Wessner, E. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Inst.). Nov 1973. 31p. Dep. NTIS (U. S. Sales Only) $3.75.

A method of on-line gamma-spectra evaluation by means of a small computer, employing Fourier transforms, is described. The program performs the acquisition and recording of data, then the Fourier transform properties are used to smooth the spectra. By employing the appropriate apparatus function in the transform domain the improvement of resolution is achieved which permits in cases of good statistics to resolve double peaks spaced as close as 1/10 of FWHM. The program is written partly in PALD, partly in FOCAL-12 and can be run on a PDP-12 computer with 8 K memory. With slight changes it is also possible to run it on a PDP-8. (auth)

26913 (UCRL-74828) RECENT ADVANCES WITH HgI_2 X-RAY DETECTORS. Swierkowski, S. P.; Armantrout, G. A.; Wichner, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Nov 1973. 12p. (CONF-731112-31). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

HgI_2 x-ray detectors up to 16 mm^3 have been made from single crystals grown from the vapor phase. Crystal growth, detector fabrication, and transport properties are described. Resolutions of 850 eV FWHM at 5.9 keV and 4.3 keV FWHM at 122 keV have been measured at 25°C in air. (auth)

26914 NEW PROCEDURES FOR THE PROCESSING OF GAMMA SPECTRA BY COMPUTER. Junod, E. (CEN, Grenoble, France). J. Radioanal. Chem.; 15: No. 2, 647-656(1973). (In French).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The author remarks upon the detailed technique described in an article published in the Nuclear Instruments and Methods. He tries to explain the variety of the gamma-spectrometry program. Then the original points of his work is given. These are: criteria for the automatic investigation of the peaks, grouping of the multiplets, the nature of the parameters of the functions to be adjusted, and the presentation of the results. (auth)

26915 METHOD FOR SYSTEMATICALLY ANALYZING Ge(Li) PHOTOPEAKS. Steyn, J. J. (NUS Corp., Washington, DC); Reier, M. J. Radioanal. Chem.; 15: No. 2, 669-673(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A relatively straightforward method of fitting Ge(Li) photopeaks with a Gaussian histogram is presented. The method, which is especially suited to photopeaks which are distributed over a relatively small number of channels, determines photopeak area, pulse height, resolution and the residual background. Results are given to indicate the Gaussian distribution of the experimental data from -1σ to $+6\sigma$. (auth)

26916 COMPUTER ANALYSIS OF WEAK SPECTRAL COMPONENTS IN GAMMA-RAY SPECTRA. Yule, H. P. (NUS Corp., Washington, DC). J. Radioanal. Chem.; 15: No. 2, 695-705(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Optimal accuracy and precision for relatively weak gamma spectral components were the goal of this study. Such components exhibit small photopeaks situated on large Compton continua; an example of this situation often occurs in measurement of low levels of mercury in biological samples. In this study, four calculational methods were tested, i.e., peak area, spectrum stripping, least squares, and peak fitting. All the methods were reasonably accurate on the average. Of significance here is the spread of individual results; the least squares results provided the smaller spread in results, but stripping did almost as well. The other two methods displayed poor precision. In conclusion, the least squares technique gave the best results in terms of accuracy, precision, and ease of application. (auth)

26917 PRECISE Ge(Li) SPECTROMETRY AT HIGH AND VARIABLE COUNTING RATE. Adams, F. (Inst. of Geophysics, Brno); Hoste, J.; Bartosek, J.; Masek, J. J. Radioanal. Chem.; 15: No. 2, 479-488(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

New circuits are presented to determine precisely the counting losses suffered in the entire gamma-ray spectrometer and to allow automatic correction for them even in the case of time-dependent counting rates as encountered in the measurement of short-lived radioisotopes. Experimental proof is given that the proposed circuitry allows accurate quantitative measurements in gamma-ray spectrometry. With counting rates up to 20,000 cps losses amount to less than 1.5%. (auth)

High Energy Physics Instrumentation

Refer also to abstract 27755.

26918 (CERN-74-4) IMAGE INTENSIFIER CAMERA FOR STREAMER CHAMBER PHOTOGRAPHY. Gentsch, H.; Gygi, E.; Hanney, M.; Schneider, F. (European Organization for Nuclear Research, Geneva (Switzerland)). 25 Feb 1974. 16p. Dep. NTIS (U. S. Sales Only) $4.00.

A three-stage image intensifier camera is described which makes it possible to record on film tracks of an isotropic streamer chamber. The precision of reconstruction of a distorted image is given. (auth)

26919 (JINR-P11-7685) MAGNETIC FIELD INTERPOLATION. Zhmyrov, V. N.; Somov, L. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The magnetic field for the SP-130 magnetic spark chamber was measured to an absolute precision of 0.1%. The magnetic field measurements were treated in two different ways by different analysis programs. The first program used only the values of the field on the boundary of the measurement volume, and then reconstructed the magnetic field throughout the volume. The second analysis method used the volume measurements directly. The comparison of the two values of the magnetic field at the same points provided a valuable check of errors in the measurements. The calculated field was found to be systematically larger than the measured field of the magnetic field by 0.1%. To decrease the table of the field, "weedence" had been performed with the help of the square interpolation. That has al-

lowed the volume of the table to be decreased from 100,000 to about 7,000, while the accuracy of the restoration of the magnetic field has proved better than 0.1%. (auth)

Radiometric Instruments

26920 MEASURING THE THICKNESS OF PARTS BY ELECTRON ABSORPTION. Gruzin, P. L.; Rodin, A. M. (Moscow Physical Engineering Inst.). Ind. Lab. (USSR)(Engl. Transl.); 39: No. 1, 56-59(Jan 1973).

Translated from Zavod. Lab.; 39: No. 1, 35-39(Jan 1973).

The absorption of B radiation may be used not only for monitoring the thickness of parts but also in some cases for detecting the kind of defects which lead to a local change in thickness. Monoenergetic electrons obtained from an electron gun instead of B-emitting isotopes were used to determine the surface density of thin foils. It was shown that the boundary of the transmission/energy curve could be used to measure sample thickness to a high accuracy. However, the energy of the beam had to be changed for every sample. The method greatly increases the accuracy of thickness measurements and also sharply increases the sensitivity of defect detection in samples of fairly small thickness. (TFD)

26921 MEASUREMENT OF THE GAS DENSITY IN A NONSTATIONARY SUPERSONIC STREAM BY THE METHOD OF ABSORPTION OF X RADIATION. Anufriev, A. A.; Sakharov, V. P. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 8, 1169-1173(Aug 1973).

Translated from Izmer. Tekh.; 16: No. 8, 34-36(Aug 1973).

Systems for measuring the density field in a supersonic gas flow in an adiabatic compression apparatus by means of the absorption of soft x rays in the 10^{-1} to 10^{-2} kg/m^3 band are examined. Operational principles and accuracy of the systems are discussed. (WHK)

26922 COUNT-RATE INSTABILITY IN GAMMA-RAY TRANSMISSION EQUIPMENT. Reginato, R. J. (Water Conservation Lab., Phoenix, AZ). Soil Sci. Soc. Amer., Proc.; 38: No. 1, 156-157(1974).

Significant errors in measuring the bulk density and water content of soils can result from a procedure commonly used with gamma transmission equipment. The detector probe can be exposed directly to the unattenuated gamma source when moving from a standard absorber to the soil. Under this high-exposure condition, 20 to 30 min may be required before the system will stabilize and reliable count rates can be taken. To avoid this difficulty, three alternative techniques are suggested. The alternative found most desirable for existing conditions was to take a standard count rate in the soil pedon where the bulk density remained constant, thus eliminating the necessity of exposing the detector to the unattenuated gamma source. (auth)

26923 FAST NEUTRON ABSORPTION IN MOISTURE MEASUREMENTS BY THE NEUTRON METHOD. Kreft, A. (Inst. of Nuclear Physics and Techniques, Krakow). Nukleonika; 18: No. 12, 615-623(1973).

The question of the fast neutron absorption is discussed from the point of view of the calibration of neutron moisture gauges. An approximate method is proposed for calculating the probability that the neutron of a given energy would escape the absorption during slowing down in the medium. The method is employed for the water-saturated sandstone, limestone, dolomite, and some types of soils. It is shown that the probability of non-capture in slowing down depends on the moisture content of the soil and changes in the range over a dozen percent. (auth)

26924 SCANNING SYSTEM USING RADIOACTIVE RADIATION IN CIGARETTE ROD MAKING MACHINE. Powell, G. F. W. (to Molins Ltd.). US Patent 3,795,802. 5 Mar 1974. Priority Date 14 May 1970, United Kingdom of Great Britain and Northern Ireland. 8p.

A scanning system for a cigarette-making machine or other continuous rod-making machines has a radiation source passing a beam into an ionization chamber comprising a positive rod electrode surrounded by a tubular negative electrode, and the output current is fed via a responsive-correction circuit which compensates for the slowness of the response of the ions in the ionization chamber. (Official Gazette)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstract 26894.

26925 (PEM-12) NUCLEAR EMP: TEST REPORT ON CONDUCTED CURRENT SHIELDING EFFECTIVENESS OF BAYONET CONNECTOR SHELLS WITH FINGERS. Miller, J. S. (North American Rockwell Corp., Los Angeles, Calif. (USA)). 1971. 20p. Dep. NTIS $4.00.

Tests were conducted to measure the shielding effectiveness (SE) of the shell-to-shell interface of sample bayonet connector shells with fingers. A quadraxial test fixture consisting of a triaxial input circuit and a 50 ohm coaxial output circuit was used. Samples of MIL-C-38999B connectors from Bendix, Cannon, and Hughes were tested. Test procedures included reflection and resistance measurements, and consideration of variables such as finger slot width, millivolt drop, finish, finger attachment method, insert removal, coupling ring lubricant, and current amplitudes over frequencies from 200 KHz to 50 MHz. Detailed test results and diagrams of test apparatus are included. Connectors having narrow gaps (slot width) between fingers and low finger contact resistance had the best attenuation. (auth)

26926 (SLA-73-1122) COMBINED EFFECT OF IONIZING RADIATION AND BIAS-TEMPERATURE STRESSING ON CMOS INVERTERS. Pease, R. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1974. Contract AT(29-1)-789. 26p. Dep. NTIS $4.50.

When "hardened" CMOS inverters are exposed to ionizing radiation under positive gate bias, a negative shift in the n-channel threshold is generally observed. In this study, a net positive shift resulted when such irradiated devices were subsequently given a bias-temperature stress. This effect is explored for temperature, bias, total dose and manufacturing process dependence. A model is proposed to account for the findings. (auth)

26927 TRACK GEOMETRY IN PLASTIC FOILS IRRADIATED WITH ALPHA PARTICLES. Somogyi, G.; Paul, D. (Magyar Tudomanyos Akademie, Debrecen, Hungary). Radiat. Eff.; 20: No. 3, 181-186(Nov 1973).

Relationships are given for the calculation of the etching properties of tracks in a complex alpha-ray pattern obtained in plastic track detectors. Calculations are presented for cellulose acetate and polycarbonate foils. Etch-pit forms studied by electron microscopic techniques are compared with the calculated data. (auth)

26928 CHARACTERISTICS OF 1.0 MeV ELECTRON-IRRADIATED SURFACE-CONTROLLED SILICON JUNCTION DIODES. Walker, J. W.; Sah, C. T. (Univ. of Illinois, Urbana). Radiat. Eff.; 20: No. 3, 187-195(Nov 1973).

The effects of 1.0 MeV electron irradiation on the reverse bias leakage current of diffused silicon junctions have been determined. The leakage current can be divided into surface components and bulk components. The conditions necessary to cut off the surface components have been determined. The increase in the bulk leakage current has been related to an increase in the diffusion current at low fluxes and to generation current from an $E_V + 0.386$ eV center in the depletion region at high fluxes. (auth)

Miscellaneous Instruments

Refer also to abstracts 26607 and 28747.

26929 (AD-770428) PARTICLE PENETRATION INTO PITOT GAUGES IN SUPERSONIC DUSTY FLOWS. Gerber, N.; Chou, D.; Sedney, R.; Bartos, J. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Oct 1973. 37p. (BRL-1677). NTIS $3.00.

Pitot tube gauges located near the ground are used to measure dynamic pressure in large scale blast tests carried out on desert sites. The penetration of dust particles into the interiors of pitot tubes is studied. The particles are in equilibrium with supersonic airflows behind shock waves propagating into still air. This study is part of an overall effort to determine the effect produced by impact of small particles (e.g., dust raised in strong ground level explosions) on the output of sensors in total pressure gauges. Specifically, hemispherical nose and flat nose pitot tubes are treated, and shock waves traveling with Mach numbers ranging from 2.5 to 10.0 are considered. The corresponding overpressures vary from 6.1 to 115.5 atmospheres. (auth)

26930 (FRNC-TH-438) THEORETICAL STUDY OF A 14-MeV NEUTRON COLLIMATOR FOR NEUTRON THERAPY. Nguyen-Thuy-Thai (Grenoble-1 Univ., 38 (France)). 1973. 81p. (In French). Dep. NTIS (U. S. Sales Only) $7.25.

Thesis.

A theoretical study is presented of the characteristics of a neutron collimator. It is shown that the contribution of scattered neutrons to the total dose is very small in comparison with that due to the transmitted neutrons. Transmission calculations

enabled the most suitable arrangements of materials for the construction of a fast neutron collimator having therapeutic applications to be determined. The principal requirements were: a fast neutron dose in the beam/neutrons outside the beam ratio of ≥100; a fast neutron dose in the beam/thermal and epithermal neutron dose ratio of ≥200; a neutron dose in the beam/γ dose ratio of ≥10. If the γ and thermal neutron doses are relatively easily satisfied, then the reduction of the fast neutron dose at the boundaries of the irradiation field is more difficult to achieve because of the very large penetration power of the fast neutrons in most of the materials used. It is shown that the best compromise appears to be a collimator having a steel structure and 1 cm thick tungsten plate walls ensuring a reduction of up to 1% for the fast neutron dose at a distance of about 10 cm from the collimator axis (i.e., at about 2.5 cm from the boundary of the irradiation field). (FR)

26931 (IFA-FN-43-1973) INSTRUMENTAL WIDTHS AND INTENSITIES IN NEUTRON CRYSTAL DIFFRACTOMETRY. Grabcev, B. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

The amplitude and the shape of the quasielastic resolution function of a neutron two-axis spectrometer are calculated in the Gaussian approximation. Special attention is given to the explicitness of the formulas as well as to their absolute character, avoiding any unknown proportionality factors. The resolution function of the spectrometer is used for the calculation of the widths and integrated intensities of Bragg peaks of perfect and mosaic imperfect single crystals as well as of polycrystals. (auth)

26932 (INR-1465) NMR MAGNETOMETER FOR REMOTE MEASUREMENT OF HOMOGENEOUS MAGNETIC FIELD. Bienkowski, A.; Zemlo, L. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 12p. Dep. NTIS (U.S. Sales Only) $4.00.

A nuclear magnetic resonance magnetometer for remote measuring of homogeneous magnetic fields in the range 0.15 to 1.45 T is described. The field is measured in the whole range with one probe only. It was found that the signal-to-noise amplitude ratio in the range 0.15 to 0.82 T is 25:1, and in the range 0.82 to 1.45 T is 3:1. (auth)

26933 (K-TL-408) MERCURY DETECTION DEVICE. Jones, H. C.; Woodfin, S. B.; Henderson, E. R. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 20 Mar 1974. Contract W-7405-eng-26. 5p. Dep. NTIS $4.00.

An improved mercury vapor flow photometer is described which is capable of determining mercury in concentrations of 1 microgram per liter (1 ppb) in water and urine when a 50-ml sample is used. A reactor is employed in conjunction with the photometer to chemically reduce the mercury in the liquid to its metallic form. The reactor is a simple scrubber bottle in which the liquid sample is acidified and reduced to the metal with a stannous chloride solution. The elemental mercury is swept from the reactor through the photometer with a 2-cfh flow of air. A mercury lamp emitting light at 2537 Å in the photometer provides a mercury reference which is attenuated by mercury vapor in an amount proportional to the concentration of mercury in the sample being measured. (auth)

26934 (LBL-1(Vol. 4)) INSTRUMENTATION FOR ENVIRONMENTAL MONITORING: BIOMEDICAL. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 15 Dec 1973. 184p.

A comprehensive survey of instrumentation for environmental monitoring is being carried out by the Lawrence Berkeley Laboratory under a grant from the National Science Foundation. Instruments being investigated are those useful for measurements in Air Quality, Water Quality, Radiation, and Biomedicine related to environmental research and monitoring. Consideration is given to instruments and techniques presently in use and to those developed for other purposes but having possible applications to this work. The results of the survey are given as (a) descriptions of the physical and operating characteristics of available instruments, (b) critical comparisons among instrumentation methods, and (c) recommendations of promising methodology and development of new instrumentation. The survey material is compiled in five loose-leaf volumes which will be periodically updated. This volume deals with those parameters which affect human, animal, and plant life presently considered to arise from environmental problems. Hospital instrumentation is not included. Biomedical problems arising from contamination of the air or water are discussed. Sections presented include the introduction and metals (mercury, cadmium, and lead). Also, atomic spectrometry is discussed, and specification sheets are included for a number of atomic absorption spectrophotometers and atomic emission spectrophotometers. (WHK)

26935 (SLA-73-1115) NONDESTRUCTIVE DETERMINATION OF THE AREAL DENSITY OF ^{235}U FILMS. Nelson, G. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 9p. Dep. NTIS $3.00.

A simple, rapid, and nondestructive method has been developed for measuring the areal density of enriched uranium films. With this method, precisions of three percent or better can routinely be obtained for ^{235}U areal densities between 4 and 75 mg/cm^2. A collimated Ge(Li) detector is used to measure the intensity of the emitted gamma rays from which the areal density can be calculated. (auth)

26936 (TID-26488) CAMAC: SERIAL SYSTEM ORGANIZATION. A Description. (USAEC, Washington, D. C.). Dec 1973. 86p. Dep. NTIS $5.45.

A Serial Highway for interconnecting CAMAC crates and a System Controller is described. The Serial Highway uses either a bit-serial or a byte-serial mode of transferring data and control information. Up to 62 crates may be accommodated. In addition, a Serial Crate Controller (SCC) is defined that may be used in either bit-serial or byte-serial mode, at the option of the user. (auth)

26937 NEUTRON-FLUX RESPONSIVE SWITCH. Parker, R. (to United States Atomic Energy Commission). US Patent 3,783,285. 1 Jan 1974. Filed date 6 Sep 1972. 4p.

A neutron-activated switch having a neutron-flux sensitive disk soldered to a spring steel strip is described. The spring steel strip has an end attached to one electrical contact while the other soldered end is bent away from a second contact. A neutron burst impinging on the neutron-sensitive disk generates heat which melts the solder thereby allowing the switch to close. The switch has application in circuits used in specimen crack detection systems. (Official Gazette)

26938 CONSIDERATION OF THE ABERRATION DURING CALCULATION OF THE RESOLVING CAPACITY OF SOME MASS SPECTROMETERS. Arifov, U. A.; Kogan, V. I. (Inst. of Electronics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 5, 59-62(1973). (In Russian).

For mass spectrometers consisting of sequentially arranged electrostatic fields of cylindrical condensers and sectored homogeneous magnetic fields, deflecting ions in the opposite direction, and not having intermediate focusing between poles, formulas were obtained for the image width, dispersion, and resolving capacity with consideration of the order of magnitude of the aberration. (tr-auth)

26939 GAUGE FOR DETERMINING THE PERCENTAGE BY WEIGHT OF MOISTURE CONTAINED IN A BULK MATERIAL TRANSPORTED ON A MOVING CONVEYOR. Chen, Y. M. (to Ohmart Corp.). US Patent 3,794,843. 26 Feb 1974. Filed date 29 Dec 1972. 24p.

A moisture gage containing a gamma and neutron source is described. The gamma radiation determines the weight of the material including the moisture. The neutrons give the weight of the moisture. (TFD)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 26594, and 26642–26645.

26940 (INIS-mf-1073) ENRICHMENT OF STABLE ISOTOPES FOR REACTOR USE. Raman, S.; Bajpai, M. B. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 9p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Methods for enriching lithium-6, lithium-7, boron-10 and nitrogen-15, employed in the Stable Isotope Section, Chemical Engineering Division of the Bhabha Atomic Research Center, India, are described. The chemical exchange process is used for the enrichment of ^{6}Li and ^{7}Li. Lithium amalgam (electrode phase) and lithium chloride dissolved in n-propylamine (electrolyte phase) are contacted in a countercurrent manner through a bed of quartz sand of 0.4 to 0.5 mm in size. NO-HNO_3 exchange reaction is used for the enrichment of ^{15}N. Ion exchange methods are also adopted for enrichment of ^{6}Li, ^{7}Li, and ^{15}N. Enrichment of boron-10 was carried out by exchange distillation method. (INIS)

26941 (INIS-mf-1107) ISOTOPE SEPARATION OF SODIUM ISOTOPES BY CONCENTRATING ELECTROPHORESIS. Wiedemann, B.; Vestermark, A. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden); Stockholm Univ. (Sweden). Biokemiska Institutionen). Jan 1971. 15p. (In German). INIS.

Measurements of the isotope effects for the sodium isotopes ^{22}Na and ^{24}Na in the concentrating electrophoresis technique have been carried out using ^{23}Na as a "spacer". From the variation in the isotopic ratios $^{22}Na/^{23}Na$; $^{24}Na/^{23}Na$ within the sodium band the relative mobilities of the isotopes ^{22}Na, ^{24}Na with respect to ^{23}Na have been calculated. Also the height of a theoretical plate (HETP) and the number of plates are given. (INIS)

26942 HEAVY WATER PRODUCTION IN CANADA. Keating, R. K.; Nordby, L. R. Technical Meeting No. 4/12. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The heavy water production program in Canada to satisfy the requirements of the CANDU program is described. Three large production plants have been committed. When all of these plants are completed, their combined annual production is expected to be about 1500 Mg. (auth)

26943 URANIUM ENRICHMENT AND JAPAN'S ENERGY POLICY. Imai, R. (Japan Atomic Power Co., Tokyo). At. Jap.; 17: No. 3, 5–8(Mar 1973).

The problem of uranium enrichment is highly complicated because of political and other factors involved. Uranium fuel, however, is important to Japan for her increasing energy demands. The situation in Japan is reviewed on the aspects of the large requirement of enriched uranium, the need for long-term assurance of supply, the means of its acquisition, the enrichment technology in Japanese energy policy, and the barriers in technological development. In 1990, the annual requirement in Japan will be 13.5 million SWU kg, for the corresponding nuclear power generation at 110,000 MW(e). Among the means for the solution of the problem are Japan's own enrichment, dependence on other countries, and joint international ventures. The technology is concerned with centrifugal and gaseous diffusion processes. (JA)

26944 STUDY OF THE GAS EXTRACTION SYSTEM OF AN ULTRACENTRIFUGE. Napolitano, L. G.; Monti, R.; Losito, V. (Univ., Naples). Aerotecnica; 52: 190–198(Jun 1973). (In Italian).

Determination of the impact pressure in the extraction lines of an ultracentrifuge and of the deceleration induced by the relative system was studied. A model was constructed which relates the relative Mach number to the rigid Mach number and reveals the dependence of the former on the Knudsen number and on a dimensionless operation parameter, which, in turn, depends on the gas and on the geometry and resistance of the extraction lines. It is found that the effective Mach number of the flow surrounding the scoops first increases and then decreases when the peripheral velocity of the centrifuge increases; this latter velocity depends on the above-mentioned operation parameter. (IAA)

26945 HEAVY WATER PRODUCTION. Part 1. Villani, S. (CISE, Milan). Energ. Nucl. (Milan); 21: No. 2, 77–86(Feb 1974). (In Italian).

Various methods are reviewed for producing heavy water. For each of them an account is given of the recent developments and of the economic limits that most of them are meeting. The first part of this review will deal with the analytical techniques, distillation methods and electrolysis. The second part, to be published, will cover the processes, both monothermal and bithermal, based on chemical exchange reactions. (auth)

26946 HEAVY WATER PRODUCTION. II. Villani, S. (CISE, Milan). Energ. Nucl. (Milan); 21: No. 3, 139–154(Mar 1974). (In Italian).

The chemical exchange processes for heavy water production both bithermal and monothermal are illustrated. Some information is given concerning the Savannah River and Bruce plants. Both are based on the Girdler-Spevack (GS) process. The systems NH_3/H_2, amine/H_2 and H_2O/H_2 are reviewed. (auth)

26947 PROCESS AND PLANT FOR THE ISOTOPIC ENRICHMENT OF URANIUM BY MEANS OF GASEOUS DIFFUSION. Biondi, L.; Vaudo, A. (to Montecatini Edison SpA). US Patent 3,792,570. 19 Feb 1974. Priority Date 29 Oct 1970, Italy. 14p.

A process for the enrichment of uranium hexafluoride with respect to ^{235}U by means of gaseous diffusion through a set of diaphragms called "barriers" is presented. (TFD)

Isotopic Power Sources

26948 (BNWL-877) DIVISION OF ISOTOPE DEVELOPMENT PROGRAMS QUARTERLY REPORT, MAY–JULY 1968. Drumheller, K. (ed.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1968. Contract AT(45-1)-1830. 73p. Dep NTIS $5.75.

Declassified 29 Aug 1973.

Results of the promethium isotopic fuels program and related research for the period May–July, 1968 are presented. (RCK)

Radiation Sources

Refer also to abstract 26802.

26949 DEVICE FOR CHARGING AND DISCHARGING HEADS OF RAY EMITTERS. Scheininger, L.; Nette, O. (to Siemens Aktiengesellschaft). US Patent 3,795,804. 5 Mar 1974. Priority date 17 Aug 1970, F. R. Germany. 4p.

A device is provided for charging and discharging heads of radiation emitters through the outlet of a cone. The device has a source carrier with a radioactive element, a transporting container for the source carrier, and a charging rod for moving the source carrier which provides protection against radiation in its cross-sectional range. The device is particularly characterized in that the source carrier can be firmly held in the head of the radiation emitter without moving and can be firmly coupled with the charging rod at the front side in the direction of movement, the source carrier carrying the radioactive element in the center of the coupling surface. (3 claims, 3 drawing figures) (Official Gazette)

26950 CALCULATION OF DOSE RATE DISTRIBUTIONS AROUND ^{192}Ir RADIOACTIVE SOURCES BY AN ELECTRONIC COMPUTER. Bulski, W.; Majenki, L.; Glebultowicz, T. (Univ. of Warsaw). Postepy Fiz. Med.; 7: 215–223(1972). (In Polish).

The GIER computer program has been written for calculation of dose rate distributions around the ^{192}Ir radioactive line sources. A method of illustration of dose distribution by a line printer is presented. (auth)

Industrial Uses

Refer also to abstracts 26988, 26998, and 28688.

26951 (BNL-50390) CONCRETE-POLYMER MATERIALS. Fifth Topical Report. DePuy, G. W.; Kukacka, L. E. (eds.). (Brookhaven National Lab., Upton, N. Y. (USA); Bureau of Reclamation, Denver, Colo. (USA)). Dec 1973. 114p. (RECERC-73-12). Dep. NTIS $5.45.

The development, properties, and uses of polymer-impregnated concrete, polymer-concrete, and polymer-cement concrete are summarized. (TFD)

26952 (CEA-CONF-2478) RADIOSTERILIZATION OF MEDICAL MATERIALS AND THE RADIOPRESERVATION OF FOODS. Eymery, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38

(France)). May 1973. 19p. (In French). (CONF-730682-1). Dep. NTIS (U.S. Sales Only) $3.00.

From days of innovations conference; Paris, France (2 Jun 1973).

The ways in which ionizing radiation interacts with matter are outlined and the biological action of radiations is discussed. The chemical effect of radiation is indicated. The primary types of irradiation installations are described. The applications of irradiation to the sterilization of medical supplies and the preservation of foods are discussed. (JSR)

26953 (CEA-CONF-2479) TENDENCIES AND RECENT PROGRESS OF TECHNICAL APPLICATIONS OF RADIOELEMENTS. Hours, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France)). Jun 1973. 7p. (In French). (CONF-730682-2). Dep. NTIS (U.S. Sales Only) $3.00.

From days of innovations conference; Paris, France (2 Jun 1973).

A brief review is given of new areas of application of radioisotopes in radiometric gages, chemical analysis, radiotracers, industrial radiography, and radioisotope batteries. (JSR)

26954 (EURISOTOP-84) APPLICATION OF RADIOACTIVE TRACERS TO THE STUDY OF DISTILLATION AND RECTIFICATION IN THE ZINC AND CADMIUM INDUSTRY. Akerman, K. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). Dec 1973. 94p. (In German). Dep. NTIS (U. S. Sales Only) $7.75.

Distillation occurs in all stages of the production of zinc and cadmium. This applies both to the working up of the ore and to the gaining and refining of the metal. Radioactive tracer techniques to examine this process are described. (TFD)

26955 (INIS-mf-755) COMBINED METHOD OF HEAT WITH IRRADIATION TREATMENT FOR STERILIZATION OF FRUIT PUREE. Tencheva, S.; Minkova, M. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 14p. (In Bulgarian). INIS.

From 2nd national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Apple puree was treated with radiation in order to study the following effects: inactivation of initial microflora; inactivation of polyphenol oxidase and peroxidase; and organoleptic and chemical changes. Microbiological analyses showed that when doses of 100 to 400 kR were applied the microflora were significantly reduced but sterility was not obtained. A combination of heat treatments of 50 to 60°C for time periods of 10 to 30 min with radiation doses of 250 to 400 kR made it possible to obtain sterile puree. (HLW)

26956 PRACTICAL EXPERIENCE IN 5 YEARS' γ-IRRADIATION STERILIZATION IN HOLLAND. Armbrust, R. F. (OPG-Gammaster Besugarzoallomas, Ede, Holland). Izotoptechnika; 17: No. 1, 1-9(Jan 1974). (In Hungarian).

26957 RADIOISOTOPE METHOD FOR INVESTIGATING THE STRUCTURAL TRANSFORMATIONS OCCURRING DURING HEAT TREATMENT OF CARBON STEELS. Bochenin, V. I. (Karaganda Polytechnic Inst., USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 1, 62-63(Jan 1973).

Translated from Zavod. Lab.; 39: No. 1, 41-42(Jan 1973).

The use of x rays from ^{55}Fe to determine the type of heat treatment to which high-carbon steels have been subjected is reported. The method establishes the width of the 211 ferrite line and shows the tempering temperature to within ±20°C. (TFD)

26958 FOOD IRRADIATION: A SURVEY. Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay). Indian J. Nutr. Diet.; 9: No. 2, 91-111(1972).

The scope for preservation of foods by irradiation is reviewed. The ability of ionizing radiations, such as gamma rays and fast electrons in the preservation of food and the sources of ionizing energy, high and low dose process and combination treatments are discussed. An important aspect of food irradiation relates to the demonstration of safety of products for human consumption. Banning some anamolies, no clearly demonstrable toxicity has been reported for irradiated foods. This aspect and the categorization of food irradiation as akin to the use of a chemical additive is discussed. Research and development work on the scope for radiation preservation of perishable foods that are being carried out in the developed and developing nations of the world is discussed. A special reference is made to the intensive studies that are in progress at the Bhabha Atomic Research Centre in India on programs on grain disinfestation, and radiation preservation of perishable food items like seafood, tropical fruits like mangoes and bananas which are of economic importance to the country. (INIS)

26959 MICROBIOLOGICAL EVALUATION OF SUTURE ITEMS BEFORE RADIATION STERILIZATION. Oesterberg, B. O. (Johnson and Johnson AB, Sollentuna, Sweden). Appl. Microbiol.; 26: No. 3, 354-358(Sep 1973).

Microbiological contamination levels of suture samples taken at various stages of the manufacturing process in a new hygienically controlled plant were determined by employing a membrane filtration technique. Both raw material and materials handled manually in the production process were tested to assess the effect of manual handling on the product contamination level. Evaluation of the efficacy of contamination control, however, was directed primarily to the finished, packaged products, just prior to the processing with cobalt 60. The suture material for testing was divided into two groups, namely, wet and dry products, the wet being packaged in a special tubing fluid consisting mainly of isopropyl alcohol. Initial contamination results are reported as the average of values obtained on the test day and the preceding 9 consecutive production days. A total of 1,787 suture samples tested in the dry group showed daily averages varying between 2.1 and 14.8 contaminants per suture. The 2,980 wet-packaged suture samples tested gave daily averages varying from 0.7 to 4.2 contaminants per suture. The highest values obtained for an individual suture were 400 for the dry and 89 for the wet. Identification studies of the contaminants revealed that fungi predominated. Most of the bacterial contaminants proved to be spore-forming rods. (auth)

26960 COEFFICIENTS OF TRACER TRANSFER THROUGH MEMBRANES. Part VI. Dorabialska, A.; Hawlicka, E.; Pionka, A. (Technical Univ., Lodz, Poland). Nukleonika; 18: No. 12, 609-613(1973).

A modification of the diaphragm cell method for diffusion coefficient determination is presented. A recent paper of Turq and Chemla, on the self-diffusion coupled with diffusion for the aqueous solution of sodium chloride prompted this series containing some further experimental details. So far the tracer transfer through a semipermeable cellophane membrane separating two unstirred compartments has been studied. A simple and very convenient method for determination of tracer transfer coefficients through a membrane separating stirred compartments is presented. Since these tracer transfer coefficients are proportional to the respective diffusion coefficients the presented method can be used for the determination of diffusion coefficients in any kind of process discussed previously. The serious need for such a method is clearly evident from the quoted paper. (auth)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 26653, 26988, 27031, and 27104.

26961 (AEC-tr-7507, pp 15-22) SEDIMENTATION ANALYSIS OF DNA OF IRRADIATED BACTERIA. Osakovskii, V. L.; Ravin, V. K. (Inst. of General Genetics, Moscow). 1973. Translated From Radiobiologiya; 13: No. 5, 662-668(1973).

In Radiobiology.

On the basis of an analysis of the sedimentation of DNA isolated from irradiated cells in initial sucrose gradient, it was shown that neither uv irradiation nor the process of excision of photoproducts leads to the appearance of complete breaks in the DNA molecule in vivo. A quantitative calculation shows that if breaks do arise, their frequency is lower than one break per 1400 induced or 1000 excised thymine dimers. (tr-auth)

26962 (AEC-tr-7507, pp 23-29) CHANGE IN THE ABSORPTION OF PROTEIN IN THE REGION OF AMIDE I AFTER IRRADIATION. Kharchenko, L. I.; Pavlovskaya, T. E. (Inst. of Biochemistry, Moscow). 1973. Translated From Radiobiologiya; 13: No. 5, 669-673(1973).

In Radiobiology.

The absorption of human serum albumin in the region of the absorption band of Amide I was studied after irradiation of a 10% aqueous solution of protein and a dry preparation with the γ rays of ^{60}Co at doses close to one ionization per molecule. The observed changes in the intensity of the band of Amide I are related to a disruption of the secondary structure of the protein. A dependence of the effect on the presence of oxygen during irradiation was demonstrated. (tr-auth)

26963 (AEC-tr-7507, pp 95-101) FORMATION OF LIPID PIGMENTS IN THE TISSUES OF IRRADIATED ANIMALS. Vertushkov, V. T.; Ivanov, I. I.; Tarusov, B. N. (Moscow State Univ.). 1973. Translated From Radiobiologiya; 13: No. 5, 723-728(1973).

In Radiobiology.

The colored products that appear in the tissues of the spleen, blood, and bone marrow of mice after x irradiation at a dose of 750 R were studied. It was established that these compounds are formed in the polymerization of products of oxidation of unsaturated lipids, induced by irradiation. It was shown that a number of radioprotectors, including adrenalin, serotonin, and histamine, sharply accelerate the process of polymerization of lipids, thereby retarding the accumulation of peroxides and other oxidation products. (tr-auth)

26964 (AEC-tr-7507, pp 119-123) ANALYSIS OF THE PARTICIPATION OF OXYGEN IN THE ACTION OF uv RADIATION ON ENZYMES. Kalabukhova, T. N.; Kondakova, N. V.; Eidus, L. Kh. (Inst. of Biological Physics, Pushchino, USSR). 1973. Translated From Radiobiologiya; 13: No. 5, 741-744 (1973).

In Radiobiology.

It was shown that oxygen influences the photolysis of tryptophanyls, enhancing the breakdown of slow residues 2 to 3-fold. At the same time, uv inactivation of trypsin, in contrast to myosin, is not accompanied by an oxygen aftereffect. Since slow tryptophanyls in myosin can participate in the maintenance of activity, while in trypsin they do not participate, the impression is created that oxygen can affect inactivation (in the form of the oxygen aftereffect) of the enzymes for whose activity slow tryptophanyls are essential. (tr-auth)

26965 STUDIES ON LYSOSOMES AFTER IRRADIATION. I. A Quantitative Histochemical Method for the Study of Lysosomal Membrane Permeability and Acid Phosphatase Activity. Aikman, A. A.; Wills, E. D. (St. Bartholomew's Hospital, London). Radiat. Res.; 57: No. 3, 403-415(Mar 1974).

A simple histochemical method was developed which enables the permeability of lysosomal membranes to be studied semiquantitatively and the relative specific activity of lysosomal acid phosphatase to be measured quantitatively in tissue sections after irradiation. Increase in membrane permeability, but not of enzyme activity, occurs after treatment of tissue sections with solutions of low pH or injection of vitamin A into the animal. Enzyme activity measured by the method has been related to standard determinations of tissue homogenates. (auth)

26966 STUDIES ON LYSOSOMES AFTER IRRADIATION. II. Lysosomal Membrane Permeability and Acid Phosphatase Activity of Lymphoid and Other Tissues After Whole-Body Irradiation. Aikman, A. A.; Wills, E. D. (St. Bartholomew's Hospital, London). Radiat. Res.; 57: No. 3, 416-430(Mar 1974).

Lysosomal membrane permeability and acid phosphatase activity were studied histochemically in sections of tissues from mice which had been subjected to 50 to 1000 rads whole-body irradiation. After a whole-body dose of 850 rads, no change in lysosomal membrane permeability or of enzyme activity was observed in liver, kidney, heart, or adrenal, but substantial increases of membrane permeability and acid phosphatase activity were observed in spleen and thymus. A dose of 100 rads caused an increase in the permeability of lysosomal membranes in the spleen and after 300 rads the membranes were fully permeable. Enzyme activity was increased, progressively, by doses up to 850 rads and even greater activation of enzyme was observed in the thymus. One hour after 850 rads, enzyme activity in spleen was significantly greater than controls, and it increased to a maximum 48 hr after irradiation. Full recovery of normal membrane permeability and enzyme activity occurred after lower doses. Increased enzyme activity is not considered to be, primarily, a consequence of increased enzyme synthesis or an artifact caused by changes in cell population. Injections of cortisone, hydrocortisone, or chlorambucil cause extensive lymphocytolysis and increase membrane permeability and enzyme activity. Lymphocytes damaged by irradiation are thus believed to release factors which cause increased permeability of the lysosomal membrane and increased acid phosphatase activity. (auth)

26967 DEPENDENCE OF CO-OPERATIVITY IN THE REACTION OF HAEMOGLOBIN WITH OXYGEN ON DEUTERIUM OXIDE CONCENTRATION AND TEMPERATURE. Cupane, A.; Palma, M. U.; Vitrano, E. (Univ., Palermo, Italy). J. Mol. Biol.; 82: No. 2, 185-192(15 Jan 1974).

Concentrated deionized solutions of hemoglobin in water were diluted with unbuffered pure ^2H_2O and left to stand for 15 to 70 hrs. Oxygen equilibrium curves were measured at different temperatures and concentrations of ^2H_2O. In 98.5% ^2H_2O Hill's constant retained its normal value at temperatures below 11°C, but was reduced by 0.4 above 11°C. This temperature effect was reversible. Lowering the ^2H_2O concentrations raised the transition temperature between the states of low and high co-operativity of the reaction. The shape of the transition curve remained unchanged. Further experiments allowed a phase diagram to be constructed that shows the boundaries between the two states: one of low co-operativity at high concentration of ^2H_2O and high temperature, and another of high co-operativity at low values of these variables. Reversibility of the isotope effect even at ^2H_2O concentration of 98.5% excludes a purely steric interpretation. Possible dynamic and co-operative interactions between the protein molecule and its surrounding water molecules are discussed. (auth)

26968 ORD OF γ-IRRADIATED AND HEAT DENATURATED DNA. Gumpelmayer, T.; Altmann, H. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf). pp 115-119 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (Ed.). Vienna; Wiener Medizinische Akademie (1971). (In German).

From 1st European biophysics congress; Baden, Austria (14 Sep 1971).

The ORD of γ-irradiated and heat denatured salmon sperm DNA was investigated. The samples were irradiated with ^{60}Co γ radiation at doses between 10 and 80 krad. The ORD of the samples, recorded 48 hrs after irradiation, shows no significant changes in the positive peak at 280 nm and the negative peak at 260 nm. There is, however, a decrease in rotational strength of the positive peak at 220 nm, but the variations are not very large. The ORD of heat denatured DNA recorded at 85°C shows significant changes. In addition to the variations reported in the literature we have observed that the peak at 280 nm splits into a double peak at this temperature. This phenomenon can only be observed at temperatures above the T_m-value. The data suggest that single strand breaks caused by γ radiation in the DNA molecule might be limited to specific regions, since the double-helical structure of the molecule is not markedly affected at doses up to 80 krad. Other mechanisms might be responsible for the structural changes found in the DNA molecules after irradiation within this dose range. (auth)

26969 CHANGES IN THE ENZYMATIC ACTIVITY OF RENNIN IN DIFFERENT PURITY SAMPLES UNDER THE INFLUENCE OF ^{60}Co GAMMA IRRADIATION. Bachman, S.; Borkowska, M. (Technical Univ., Lodz, Poland). Rocz. Technol. Chem. Zywn.; 22: 121-128(1972). (In Polish).

The influence of irradiation, using doses from 0.5 to 20 Mrad, on

the enzymatic activity of rennin protein was studied. Samples were irradiated at room temperature in the solid state (freeze dried), not deaerated, in radiation chamber ^{60}Co at about 20 kCi activity. The industrially produced rennin was purified by the dialysis method and fractionation of the sephadex gel G-75 (Pharmacia). Purification increased the susceptibility of the industrially produced rennin to irradiation. Decrease of activity for the 1 Mrad dose after dialysis was 5%, after filtration with sephadex gel was 30% for the same dose. The molecular weight of the Polish made rennin estimated by means of molecular filtration was 42,000 to 44,000. Besides this enzymatically active part of the preparation there were some other fractions of 88,000 or 20,000 molecular weight. These compounds are probably dimers and subunits of rennin that should be confirmed in further studies. The results confirm the high resistance of enzyme to irradiation, especially in biological systems. They broaden the knowledge about the influence of irradiation on the enzyme protein. The results also confirm the usefulness of the irradiation method for the sterilization of the industrial preparation. (auth)

26970 EFFECT OF IONIZING RADIATION OF THE REACTIVITY OF ε-AMINO GROUPS IN TROPOCOLLAGEN. Jelenska, M. M.; Dancewicz, A. M. (Inst. of Nuclear Research, Warsaw). Acta Biochim. Pol.; 19: 341-346(1972).

After x-irradiation of tropocollagen solution in the presence of nitrogen with 30 kilorad, the content of free ε-amino groups decreased from 36 to 26 per a-chain. This decrease was but apparent and resulted from conformational changes in tropocollagen (formation of new interchain crosslinking bonds), which block the access of fluorodinitrobenzene to some of the free ε-amino groups. (auth)

26971 X-RAY INACTIVATION STUDIES OF NONHEME IRON PROTEINS. Action of X-rays on Spinach Ferredoxin in Aqueous Solutions. Krasnobajew, V. (Univ., Zurich). Biophysik; 10: No. 3, 213-220(Oct 1973).

Exposure of aqueous spinach ferredoxin solutions to x rays results in a rapid and irreversible denaturation of the molecule. The denaturation is manifested by a decrease of the characteristic absorption of spinach ferredoxin at 320 and 416 nm, and by the concomitant liberation of ferric iron and hydrogen sulfide. The absorption decrease at 320 and 416 nm and the iron liberation are found to parallel the activity decrease in functioning as electron transfer factor in the noncyclic electron transport system in spinach chloroplasts. X-ray inactivated spinach ferredoxin does not contain iron or free SH-groups, and can be regarded as an apo-form of the native protein. This x-ray-inactivated apoprotein, however, showed a higher molar extinction coefficient at 275 nm than the apoferredoxin, and was not reconstitutable. Spinach ferredoxin was found to be even more radiosensitive than clostridial ferredoxin. A G-value of 1.25 for biological inactivation and iron liberation was found, as compared to a G-value of 0.8 for clostridial ferredoxin. (auth)

Radiation Effects on Cells

Refer also to abstracts 27081, 27082, 27084, 27085, 27104, 27121, and 27124.

26972 (AEC-tr-7507, pp 1-14) MOLECULAR MECHANISM OF DAMAGE TO CELLS AND PROTECTION FROM THE ACTION OF IONIZING RADIATION. Communication 2. Experimental Confirmations of the Mechanism of Protection. Eidus, L. Kh. (Inst. of Biological Physics, Pushchino, USSR). 1973. Translated from Radiobiologiya; 13: No. 5, 651-661(1973).

In Radiobiology.

A previous communication outlined the basic concepts of the molecular mechanism of the protection of cells from radiation damages, many premises of which can be verified experimentally. This communication discusses the literature data on our own data, confirming the basic consequences of this theory. (tr-auth)

26973 RESPONSE OF CHINESE HAMSTER (OVARY) CELLS TO PROTRACTED IRRADIATION FROM ^{252}Cf AND ^{60}Co. Nias, A. H. W.; Howard, A.; Greene, D.; Major, D. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Brit. J. Radiol.; 46: No. 551, 991-995(Nov 1973).

Chinese hamster (ovary) cells were exposed to the protracted irradiation of ^{252}Cf or ^{60}Co under conditions of aeration or extreme hypoxia. Dose response curves were computed and these indicated values for oxygen enhancement ratio (OER) of 1.42 for ^{60}Co irradiation at 100 rads/hr and 2.18 for ^{252}Cf irradiation at a mean dose-rate of 15 rads/hr. From these values the therapeutic gain factor (TGF) would be only 0.65. Values for relative biological effectiveness (RBE) would be 6.7 for aerated cells and 4.4 for hypoxic cells. It is suggested from these data that no advantage would be gained by substituting ^{252}Cf orthodox γ sources in interstitial radiotherapy. (auth)

26974 MARKER FOR MAMMALIAN DNA SEDIMENTATION. Wheeler, K. T.; DeWitt, J.; Lett, J. T. (Univ. of California, San Francisco). Radiat. Res.; 57: No. 3, 365-378(Mar 1974).

DNA from Chinese hamster ovary (CHO) cells which had been irradiated with 1 krad of x rays was sedimented in alkaline sucrose gradients with the single strands of DNA and large DNA-containing species which can be released from mammalian cells. It was found that the CHO DNA profile is suited for use as a marker in such circumstances because it has both a characteristic shape and principal component (~165S) which are substantially independent of DNA concentration, EDTA concentration, and lytic storage time. The sedimentation rate of the principal component varied with rotor speed and radius as predicted by Zimm for single-stranded DNA molecules with a molecular weight of approximately 5×10^6 daltons. The irradiated CHO cells can be frozen and stored without changing the sedimentation characteristics of the marker DNA. (auth)

26975 LETHAL EFFECT OF NEAR-ULTRAVIOLET IRRADIATION ON MAMMALIAN CELLS IN CULTURE. Wang, R. J.; Stolen, J. D.; Landa, F. (Univ. of Missouri, Columbia). Nature (London); 247: No. 5435, 43-45(4 Jan 1974).

Experiments are described to study the effect of "black light" (near-ultraviolet) on mammalian cells in tissue culture. The cells used were mouse 3T6, Chinese hamster V79 clone, and human D98/AH_2, and the light sources were General Electric F15T8 BLB integral filter black light tubes with emission in the 290 to 420 nm range, peaking at 365nm. The culture disk lids excluded irradiation below 300 nm. Exposure intensity was 4μ W/mm^2 at the cell surface. The cells were killed by the irradiation, both reproductively, as evidenced by clone-forming ability, and physiologically, as evidenced by staining with trypan blue. The killing effect was, however, density dependent, human and mouse cells being killed when up to 10^5 cells were plated per 60 mm tissue culture disk, and hamster cells at densities up to 10^4 cells per disk. When 10^6 cells were plated no decrease in viability was observed. Differences in the effects, at the molecular level, of far-ultraviolet (<300nm) and near-ultraviolet (300 to 420 nm) radiation on biological systems are described; these are quite different. Far-ultraviolet leads to lethality by directly altering the DNA through dimer formation, while near-ultraviolet, at the dosage used in the experiments described, does not produce dimers in bacterial systems. It is conceivable that toxic photoproducts are produced in the culture medium which, when taken up by the cells, leads to lethality, and the finding that the cell killing effect is density dependent could be due to the fact that when more cells were present the amount of photoproducts absorbed by each cell was correspondingly less. The possible mutagenic and carcinogenic action of the radiation also needs to be carefully examined. (UK)

26976 REPAIR OF DNA DAMAGED BY UV$^-$ AND X-IRRADIATION IN CULTIVATED NORMAL HUMAN, XERODERMA PIGMENTOSUM, AND BLOOM CELLS. Kleijer, W. J.; Bootsma, D. (Medische Faculteit, Rotterdam). pp 129-133 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From 1st European biophysics congress; Baden, Austria (14 Sep 1971).

Repair DNA synthesis and excision of thymine dimers after uv-irradiation are strongly reduced in cells from xeroderma pigmentosum (XP) patients. After x-irradiation however the repair replication and the break-rejoining activity in different XP-strains appears to be normal. XP-cells therefore are thought to be deficient in one of the steps involved in the excision of pyrimidine dimers. Investigations to prove the deficiency of an uv-specific endonuclease in XP-cells by measuring breaks in the DNA after uv-irradiation had no success. The incision step seems to be the rate-limiting step, breaks are therefore not accumulated to a detectable level in normal cells. Several compounds were found to inhibit the rejoining of x-ray induced breaks. Application of these inhibitors after uv-irradiation still did not lead to accumulation of breaks. These results fit in a hypothetical model for the uv-damage repair mechanism in which an endonuclease molecule can only make a new incision after the complete repair of a preceding lesion. In cells from patients having Bloom syndrome no defects in the repair of uv- and x-ray damage could be observed. (auth)

26977 HISTOCHEMICAL STUDIES ON GLIAL CELLS IRRADIATED IN VITRO WITH A 5000 R DOSE OF GAMMA RAYS. Ostenda, M. (Centrum Medycyny Doswiadczalnej i Klinicznej, Warsaw). Neuropatol. Pol.; 413-420(1972). (In Polish).

The following events were observed in glial cells irradiated

in vitro one time with 5000 R of gamma rays: drop in LDH and SDH activity and in numerous astrocytes the presence of glycogen deposits; in numerous cells enhancement of acid phosphatase activity; and in the later periods after irradiation (72 hrs to 7 days), an increase of the number of cells with degenerative changes. These events are indicative of a decreased activity of oxidative processes and enhancement of anerobic glycolysis in the cells of higher sensitivity to irradiation. The applied dose may lead to severe damages of the cells, preceded by an increase in activity of lysosomal enzymes and thereafter by degenerative changes. (auth)

26978 RESPONSE OF HUMAN LYMPHOCYTES IN CULTURE TO X-IRRADIATION. Rudnicki, T.; Sloninska, B. (Medical Academy, Poznan, Poland). Acta Physiol. Pol.; 23: 809-822 (1972). (In Polish).

Different aspects of the radiobiological response in human lymphocytes in asynchronizing cultures in vitro versus the dose and time after x irradiation were studied. Doses of 200 to 800 rads were used. The first evidences of radiation injury were interphase death and mitotic inhibition. Complete mitotic block was not observed. Normalization of the mitotic function was partial only. Abnormal mitoses and abundant chromosome aberrations go together with it. Disturbance of reproductive ability and polyploidization connected with it seem to be of limited importance. It follows from these experiments that radiation can influence every phase of the generation cycle of human lymphocytes. It seems that the restoration of human lymphocytes in vitro from radiation injury is very restricted. (auth)

26979 EFFECT OF X RAYS ON NUCLEAR AND CYTOPLASMIC PROTEIN SYNTHESIS IN L5178Y-S CELLS: DIFFERENTIAL INHIBITION. Szumiel, I.; Rosiek, O.; Budzicka, E. (Inst. of Nuclear Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Biol.; 20: 571-575(1972).

Irradiation of murine leukaemic lymphoblasts L5178Y-S with 400 rads of x rays reduces incorporation of ^{3}H-thymidine into DNA to about 80% of the control level. To examine the effect of the same dose of x rays on protein synthesis, incorporation of radioactive amino acids into the following protein fractions was determined: lysine-rich histone F1, remaining histones, acid-insoluble nuclear proteins, and cytoplasmic proteins. Radiation-induced reduction of the specific activity was most pronounced in histone F1 and the remaining histones (c. 30%). Synthesis of acid insoluble nuclear proteins was less inhibited (about 9% decrease) while only a small change (c. 3%) was observed for the cytoplasmic proteins. (auth)

26980 RADIATION DAMAGE, CAUSED BY INTERFERENCE WITH CELLULAR CONTROL OF DIFFERENTIATION AND PROLIFERATION. Wangeheim, K. H. (Kernforschungsanlage, Juelich, Ger.). pp 425-429 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Baden; Wiener Medizinische Akademie (1971).

From first European biophysics congress; Baden, Austria (14 Sep 1971).

Mitotically active cells contain a small amount of cytoplasm, whereas more cytoplasm is needed for differentiation in direct proportion to the level of ploidy. The propagation rate of both the nucleus and the cytoplasm, however, are independent of each other within certain limits. The amount of cytoplasm required for differentiation can normally only be obtained, therefore, by a cytoplasmic propagation rate which more than doubles the cytoplasmic amount per mitotic cycle. The ratio of cytoplasmic amount: ploidy- thus, determines the number of mitotic cycles the cells will pass through until differentiation and cessation of mitotic activity. Following x-irradiation, cytoplasmic propagation continues during mitotic delay, thus increasing the ratio of cytoplasmic amount: ploidy, and the cells, consequently, differentiate after a reduced number of mitotic cycles. The results suggest that these processes of early differentiation are more important than mutations to the induction of damage in proliferating tissues of higher organisms. (auth)

26981 CHARACTERISTICS OF DNA REPAIR AFTER X-IRRADIATION OF P388 LYMPHOMA CELLS. Fox, M.; Fox, B. W. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). pp 135-141 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From first European biophysics congress; Baden, Austria (14 Sep 1971).

Preparative CsCl density gradient centrifugation was used to demonstrate repair replication in P388 lymphoma cells after doses of 150 to 400 rads. The observed repair is stimulated two-fold by prior growth of cells in 5-Iodo-deoxyuridine and is not inhibited by hydroxyurea 10^{-2}M. The extensive "repair" ~10% of normal synthesis is not associated with DNA degradation. The repair, as studied by measurement of DNA specific activity and by autoradiography, is complete within 1 hour after irradiation as is the rejoining of single strand breaks studied over the same dose range by alkaline sucrose gradient techniques. The observed "repair" has been shown by autoradiography to be restricted to S cells. (auth)

26982 IMPORTANCE OF REPAIR APPLICATION FOR MAMMALIAN CELLS. Painter, R. B. (Univ. of California, San Francisco). pp 123-127 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From first European biophysics congress; Baden, Austria (14 Sep 1971).

The repair replication of DNA in x-irradiated mouse L-cells was studied by incorporation of tritium-labelled BUDR. The specific activity of irradiated cells was compared with that of unirradiated cells. The results suggest that the mechanism of repair replication, as known from studies on individuals suffering from xeroderma pigmentosum, is also important for correcting damage to DNA induced by ionizing radiation. Moreover, the system seems to act to correct constantly low level damage occurring as a result of normal metabolic action. (INIS)

26983 DEFENSE OF CUTANEOUS CELLS AGAINST UV IRRADIATION. I. Photomediated Binding of Trimethyl Psoralen to DNA of Melanoma Cells in Culture. Carter, D. M.; McMacken, M. deL. V.; Condit, E. S. (Yale Univ. School of Medicine, New Haven). J. Invest. Dermatol.; 60: 270-273(May 1973).

Pigmented and nonpigmented murine melanoma cells in culture were irradiated with ultraviolet light (365 nm) in the presence of tritiated trimethyl psoralen (^{3}H TMP) and cellular DNA was extracted. For each cell type, regardless of the presence of pigment, the rates of covalent binding of ^{3}H TMP to DNA and the saturation points reached were the same. The formation by irradiation of both monofunctional and bifunctional (crosslinking) adducts of TMP with cellular DNA was demonstrated by the resistance to enzymic and chemical hydrolysis of the DNA-^{3}H TMP complex and by the pattern of elution of extracted DNA from hydroxyapatite columns. These studies suggest that packaged intracellular melanin pigment has limited ability to protect cellular DNA from this type of photomediated injury. (auth)

26984 DNA REPAIR: A SIMPLE ENZYMATIC ASSAY FOR HUMAN CELLS. Wilkins, R. J. (Oak Ridge National Lab., TN). Int. J. Radiat. Biol.; 24: No. 6, 609-613(Dec 1973).

An assay is described based on the ability of certain endonucleases in Micrococcus luteus extracts to react specifically at sites of DNA damage, and produce single-strand breaks. The breaks were detected by sedimenting the DNA through alkali. DNA repair was assumed to occur if the number of endonuclease sensitive sites decreased during post-treatment incubation of cells. It is claimed that improvements have been obtained in an established technique by adding M. luteus extract to partially disintegrated cells, instead of to isolated purified DNA, enabling samples to be processed in 30 min with most of the manipulations at 0°C. As few as one or two endonuclease-sensitive sites per 100 million daltons of DNA could be detected. The potential of the method is demonstrated with results obtained from uv-irradiated human diploid fibroblasts. (UK)

26985 ULTRASTRUCTURAL MODIFICATIONS OF IRRADIATED CHROMOSOMES: STUDIES USING THE CRITICAL POINT METHOD. Mouriquand, C.; Gilly, C.; Wolff, C. (CEN, Grenoble, France). J. Microscop.; 17: No. 3, 80a(Jul 1973). (In French).

From annual colloquium of the French Society of Electron Microscopy; Dijon, France (4 Jun 1973).

The critical point method enables whole chromosomes to be examined revealing in particular their nucleohistonic fibers. This technique was used to examine HeLa cell cultures after exposure to 500 rads of ^{60}Co radiation. Several types of radioinduced lesion were compared with their homologues observed by optical microscopy. Vacancies appeared with varying degrees of importance: such damage varying from the localized rupture of some rare chromatidian fibers up to their almost complete disappearance. (FR)

Radiation Effects on Microorganisms

Refer also to abstracts 26959, 26961, and 26969.

26986 (AEC-tr-7507) RADIOBIOLOGY. Translation of Radiobiologiya; 13: No. 5, 651-808(1973). 207p. Dep. NTIS $7.60.

Separate abstracts were prepared for 34 of the 35 papers

presented. The other paper discusses the influence of a genetically foreign organism on the colony formation and accumulation of differentiation of transplanted hematogenic cells. (ERB)

For abstracts of individual papers see: 26961–26964, 26972, 26987–26991, 27004–27009, 27060–27074, 27113, 27123, and 27127.

26987 (AEC-tr-7507, pp 51-56) INVESTIGATION OF CERTAIN RADIOTOXINS OF E. COLI B. Kuzin, A. M.; Yurov, S. S.; Vasiloi, S. E. (Inst. of Biological Physics, Pushchino, USSR). 1973. Translated From Radiobiologiya; 13: No. 5, 691-694(1973).

In Radiobiology.

An increase in the amount of biologically active toxic substances in the cells of E. coli B after γ irradiation and the role of oxygen in their formation were demonstrated. A relationship was found between the concentration of the investigated substances and the death of cells of E. coli B and bacteriophage $T4Br^4$ under their influence. (tr-auth)

26988 (AEC-tr-7507, pp 57-63) INVESTIGATION OF THE POSSIBILITY OF FORMATION OF CYTOTOXIC SUBSTANCES IN GAMMA-IRRADIATED FRUITS AND JUICES. Frumkin, L. M.; Nakhmedov, F. G.; Bushkanets, T. S.; Bolubeva, Z. F. (All-Union Scientific Research Inst. of the Canning and Vegetable Drying Industry, Moscow). 1973. Translated from Radiobiologiya; 13: No. 5, 695-699(1973).

In Radiobiology.

The cytotoxic action of irradiated apples and apple and grape juices was determined on cells of the yeast Saccharomyces ellipsoideus and the mold Rhizopus nigricans. The growth rate and physiological activity of the test organisms were compared on nonirradiated and irradiated substrates. It was established that media irradiated in the dose range up to 1 Mrad have no significant influence on the viability of the investigated objects. Media irradiated at a dose of 1.5 Mrad caused a suppression of growth and physiological activity of the cells. An analogous effect was observed after the addition of hydrogen peroxide to the medium. (tr-auth)

26989 (AEC-tr-7507, pp 142-146) INFLUENCE OF FRACTIONAL IRRADIATION ON THE SURVIVAL AND MUTABILITY OF CHLORELLA. Sakovich, I. S. 1973. Translated From Radiobiologiya; 13: No. 5, 758-761(1973).

In Radiobiology.

In fractional irradiation of a Chlorella suspension, an effect of weakening of the action of radiation in comparison with a single total irradiation is observed. (tr-auth)

26990 (AEC-tr-7507, pp 147-151) MODIFICATION OF THE RADIOSENSITIVITY OF CHLORELLA WITHIN THE MITOTIC CYCLE. Apasheva, L. M.; Gusareva, E. V. (Inst. of Developmental Biology, Moscow). 1973. Translated From Radiobiologiya; 13: No. 5, 761-765(1973).

In Radiobiology.

The changes in radiosensitivity obtained with N-ethylmaleimide (NEM) and mercaptoethylamine (MEA) were studied on synchronously dividing Chlorella cells (strain LARG-1). NEM distinctly sensitizes the cells to the action of ionizing radiation, whereas MEA has a pronounced radioprotective effect. The degree of effectiveness of the indicated substances depends on the level of the initial radiosensitivity. On the basis of the data obtained in this work, as well as their own data published earlier, the authors conclude that the degree of effectiveness of NEM and MEA within the mitotic cycle can be explained by differences in the initial content of endogenous thiols in the cells. (tr-auth)

26991 (AEC-tr-7507, pp 198-201) USE OF CALORIMETRIC METHOD IN THE INVESTIGATION OF THE ACTION OF uv RAYS ON FUNGI. Zemlyanukhin, A. A.; Chebotarev, L. M. (Voronezh State Univ., USSR). 1973. Translated From Radiobiologiya; 13: No. 5, 800-802(1973).

In Radiobiology.

A calorimetric method was used to study the effects of uv rays on mold fungi. By comparing the values of thermogenesis during the utilization of various oxidation substrates by the fungi, it was shown that uv rays in doses not exceeding 18 mJ/cm^2 caused disturbances in the biochemical systems that supply the Krebs cycle with oxidation substrates. At higher doses of uv rays, the predominant role begins to be played by inactivation of the enzymes of the TAC. The glycolytic pathway and the system of deamination of amino acids are relatively resistant to the action of uv rays. (tr-auth)

26992 ESTIMATION OF THE BIOLOGICAL DANGER OF THE VERY HIGH ENERGY COMPONENT OF SPACE RADIATION. Akoev, I. G.; Yurov, S. S.; Leont'eva, G. A.; Livanova, Yu. A.; Achmadieva, A. H.; Fomenko, B. S.; Lebedev, V. N.; Lukanin, V. N. Life Sci. Space Res.; 11: 225-231(1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

In modelling the action of the high energy component of space radiation in a space ship, the secondary radiation resulting from the interaction of 76 GeV protons with a target was used. The radiation flow consisted of neutrons, mesons of different kinds and charges, protons, and gamma-quanta of wide energy spectrum. We studied the influence of radiation on the survival of E. coli B and $T4Br^+$ bacteriophage; on the growth, dry weight, and survival of Vicia faba; on the frequency of chromosome aberrations and number of cells with abnormal mitoses; on the rate of post-irradiation recovery according to these characteristics; and also on the yield of the r-mutants of $T4Br^+$ bacteriophage, their distribution and biochemical identification. (auth)

26993 BIOSTACK EXPERIMENT ON APOLLO 16. Buecker, H.; Horneck, G.; Allkofer, O. C.; Bartholomae, K. P.; Beaujean, R.; Cueer, P.; Enge, W.; Facius, R.; Francois, H.; Graul, E. H. (Univ., Frankfurt am Main). Life Sci. Space Res.; 11: 295-305 (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

The object of the Biostack experiment is to study the biological effects of high ZE particles of cosmic radiation in order to obtain information on the mechanism of these particles in biological matter. For this purpose individual local evaluation methods were developed that allow one to identify each biologically effective particle and to correlate the individual hitting particle with the biological effect produced. The Biostack experimental package contains a series of monolayers of selected biological objects (Bacillus subtilis spores, Arabidopsis thaliana seeds, Vicia faba radiculae, Artemia salina eggs) with each layer sandwiched between several different cosmic ion track detectors (nuclear emulsions, cellulose nitrate, polycarbonate). By this arrangement a variety of biological effects due to a single penetrating particle can be analyzed. Influence on cellular and tissue development, nuclear damages, and mutation induction are the main investigated effects. (auth)

26994 FUNGISTATIC ACTIVITY OF SOIL STERILIZED BY GAMMA RADIATION. Kusakari, S. I.; Takagi, Y. (Univ. of Osaka Prefecture, Japan). Can. J. Microbiol.; 19: No. 10, 1333-1334(Oct 1973).

Soil samples collected from a cultivated field (loam) at University of Osaka Prefecture were sifted through screen (<2 mm). The moisture content of the sifted soil was about 30% of the moisture-holding capacity. The soil samples of about 30 g were placed in 9-cm diameter petri dishes and then exposed to gamma radiation from 6×10^4 curies ^{60}Co source for 3 h in a water bath. The radiation level was 5.1×10^6 roentgens. After irradiation, the microbial population in the soil was evaluated by the dilution-plate method. Ten grams of gamma-irradiated soil, diluted with sterile distilled water $1:10^3$ was used to determine fungal and bacterial counts. Fungi were counted on Martin's medium (Martin's original) and bacteria were counted on Thornton's medium. The results are tabulated and they indicate that 5.1×10^6 roentgens are enough to kill all fungi and bacteria. Soil in petri dishes was autoclaved at 123°C for 20 min and used as a control. (auth)

26995 EFFECT OF GAMMA IRRADIATION ON CELLULAR ATP OF ESCHERICHIA COLI. Kao, I. C.; Fan, L. T. (Kansas State Univ., Manhattan). Radioisotopes (Tokyo); 22: No. 6, 303-306(Jun 1973).

Bacterial suspensions were gamma-irradiated at dose rates of 1795 to 1840 rads/min at room temperature. A recovery test was performed by growing the irradiated samples in nutrient broth for 24 hrs followed by plate incubation for 48 hrs before cell counts were performed. Quantitative extraction of cellular ATP was performed and the concentration of ATP was determined. Results indicated that although the cellular ATP showed a slight increase at relatively small doses, no significant change in the cellular ATP concentration could be observed throughout the dose range in spite of a decrease in the survival fraction. (HLW)

26996 ANALYSIS OF INDUCED MUTANTS IN ASPERGILLUS NIGER. Das, A. (Univ. of Calcutta). Mycopathol. Mycol. Appl.; 49: No. 2-3, 205-207(15 Mar 1973).

Aspergillus niger strain A 15 was treated with uv rays, gamma rays from ^{60}Co, formalin, and nitrous acid. Types of morphological mutants produced were recorded. The paper reports the relative efficacy of the mutagens as regards the types of mutants produced. (INIS)

26997 REPAIR OF RADIATION AND NON-RADIATION DAMAGES IN DNA AND ITS BIOLOGICAL SIGNIFICANCE. Waldstein, E. A.; Zhestjanikov, V. D.; Tomilin, N. V. (Inst. of Cystology,

Leningrad). pp 189-192 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From first European biophysics congress; Baden, Austria (14 Sep 1971).

Structural defects in DNA result in alteration of the Watson-Orick base pairing. However recognition of the defect by the enzyme at the first stage of excision repair is determined by chemical alterations in a single strand of DNA rather than by defect of secondary structure. UV-endonuclease from Micrococcus lysodeikticus is shown to recognize the DNA damages induced by nitrous acid. This enzyme induces breaks in DNA strand containing dimers. The effects of uvr and exr genes on mutagenic effects of a number of radiation and non-radiation agents were investigated. Hydroxylamine-induced damages leading to streptomycin-resistance in Escherichia coli do not depend on the state of both uvr and exr genes. Mutational events induced by x rays and nitrogen mustard arise in hcr^+ and hcr^- strains with the same frequency. Premutational states induced by uv, x rays, nitrogen mustard, and mitomycin C require normal function of exr gene. The role of repair in normal life activity of the cell is discussed. (auth)

26998 MICROBIOLOGICAL INVESTIGATIONS OF γ-IRRADIATED CALF SKINS. Estimation of the Sterilization Dose. Pietrucha, K. (Instytut Przemyslu Skorzanego, Lodz, Poland). Nukleonika; 18: No. 12, 633-639(1973). (In Polish).

The results of microbiological investigations of calf skins irradiated with doses ranging from 1 to 3.5 Mrads are presented. The skins were checked immediately after irradiation and within 3 and 6 months of the storage at room temperature. It was found that the skins had no effect on the survival of Bacillus pumilus E 601 bacterium used as standard. On the basis of the present results the sterilization dose for calf skins was estimated at 2.5 Mrads providing that storage period will not exceed 7 months. (auth)

26999 RAPID METHOD FOR DETECTION OF PSEUDOMONAS AERUGINOSA ON MAC CONKEY AGAR UNDER ULTRAVIOLET LIGHT. Brodsky, M. H.; Nixon, M. C. (Ontario Ministry of Health, Toronto). Appl. Microbiol.; 26: No. 2, 219-220(Aug 1973).

A simple screening technique for the detection of Pseudomonas aeruginosa colonies by their fluorescence on MacConkey agar under ultraviolet light is proposed. From 306 nonlactose fermenting cultures screened under the ultraviolet light, 108 fluorescent isolates were obtained. These were screened biochemically, with 103 (94.8%) being verified as P. aeruginosa. From the 198 nonfluorescing cultures, only one suspected P. aeruginosa was isolated. (auth)

27000 CONTROL OF AN ESTUARINE MICROFOULING SEQUENCE ON OPTICAL SURFACES USING LOW-INTENSITY ULTRAVIOLET IRRADIATION. DiSalvo, L. H.; Cobet, A. B. (Univ. of California, Oakland). Appl. Microbiol.; 27: No. 1, 172-178(Jan 1974).

Ultraviolet light was investigated as an active energy input for the control of slime film formation on optical surfaces submerged in San Francisco Bay for periods up to 6 weeks. Irradiation of quartz underwater windows was carried out from three positions: exterior to the window, from directly behind the window, and from the edge of the window with the ultraviolet (uv) energy refracted through the front of the window. Internally administered irradiation reaching levels of 10 to 30 μW per cm^2 measurable at the glass surface was effective in preventing bacterial slime film formation and settlement of metazoan larvae. When administered from the external position, over one order of magnitude more (500 to 600 $\mu W/cm^2$) uv energy was required to accomplish the same result. Irradiation from the edge position was most promising logistically and was effective in fouling control for 6 weeks. The results provide a preliminary quantitation of the energy requirement for control of the marine microfouling sequence which precedes development of macrofouling communities. (auth)

27001 REPAIR AND RECOVERY IN NORMAL AND RESPIRATORY DEFICIENT YEAST CELLS. Pohlit, W. E. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Frankfurt am Main). pp 203-207 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From 1st European biophysics congress; Baden, Austria (14 Sep 1971).

For quantitative analysis of radiation effects in living cells a cybernetic model with three different states of the cell and two different counter reactions, repair and recovery, was developed. The time constant of repair is dependent on absorbed dose. Both counter reactions, repair and recovery, are coupled through energy metabolism of the cell. All radiation reaction constants of the model can also be determined experimentally. (auth)

27002 RNA-SYNTHESIS IN DIPLOID YEAST AFTER IRRADIATION TO 50% CFA. Koch, H.; Kiefer, J. (Univ., Giessen, Ger.). pp 219-223 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From 1st European biophysics congress; Baden, Austria (14 Sep 1971).

Diploid yeast Saccharomyces cerevisiae was irradiated with uv, x rays, or α particles to yield a colony forming ability of about 50%. RNA-synthesis per cell after irradiation was measured. After uv and x rays it is increased for 26 s, 17 s and <5 s RNA. The increase for <5 s RNA is higher than for the other types measured. Photoreactivation after uv-exposure leads to an even higher increase. α-irradiation results in a decrease of RNA-synthesis per cell; the reduction is the same for 26 s-, 17 s-, and <5 s-RNA. (auth)

27003 BACTERICIDAL EFFECT OF VARIOUS COMBINATIONS OF GAMMA RADIATION AND CHLORAMINE ON AQUEOUS SUSPENSIONS OF ESCHERICHIA COLI. Venosa, A. D.; Chambers, C. W. (National Environmental Research Center, Cincinnati). Appl. Microbiol.; 25: No. 5, 735-744(May 1973).

Methods of combining gamma radiation with chloramine to disinfect aqueous suspensions of Escherichia coli were investigated. Logarithmically grown cells were exposed to the bactericidal agents sequentially (i.e., radiation followed by chloramine, and chloramine followed by radiation) and simultaneously. Regardless of which combination was used, the bactericidal effect was always less than additive. During the phase of work involving the simultaneous addition of both agents, it was observed that chloramine was destroyed more rapidly by radiation than were the organisms. Since an increase in the bactericidal effectiveness of either disinfectant by prior or simultaneous treatment of the cells with the other disinfectant was not achieved in buffered distilled water, it was concluded that disinfection of wastewater effluents by combining ionizing radiation with chloramine would not be economically feasible. (auth)

Radiation Effects on Plants

Refer also to abstracts 26986, 26992, and 26993.

27004 (AEC-tr-7507, pp 129-132) CYTOKININS AND IRRADIATED PLANTS. Kryukova, L. M.; Yur'eva, L. N.; Nazarova, L. F. (Inst. of Biological Physics, Pushchino, USSR). 1973. Translated From Radiobiologiya; 13: No. 5, 748-750(1973).

In Radiobiology.

The natural phytohormone kinetin has a stimulating effect on cell division in bean roots, irradiated with γ rays at a dose of 50 kR. At the same time, kinetin promotes a more intensive uptake of inorganic phosphate by irradiated plants after their treatment with a kinetin solution. (tr-auth)

27005 (AEC-tr-7507, pp 138-141) RELATIONSHIPS OF THE RADIOSENSITIVITY OF VARIOUS STAGES OF THE CELL CYCLE TO RECOVERY PROCESSES (FOR THE EXAMPLE OF VICIA FABA SEEDLINGS). Saichkina, S. I.; Aptikaeva, G. F.; Ganassi, E. E. (Inst. of Biological Physics, Pushchino, USSR). 1973. Translated From Radiobiologiya; 13: No. 5, 754-757(1973).

In Radiobiology.

The radiosensitivity of various stages of the cell cycle of Vicia faba seedlings is not a constant characteristic, but may vary depending on the experimental conditions: dose of irradiation, influence of inhibitors of metabolism (chloramphenicol, caffeine) or protectors (AET, MEA). It is concluded that the differences in radiosensitivity are due to the different vulnerabilities of the repair capacity of the cells at different stages of the cycle. (tr-auth)

27006 (AEC-tr-7507, pp 152-156) PROTECTIVE ACTION OF RADIOPROTECTORS IN THE GAMMA IRRADIATION OF PEA ROOT MERISTEM CELLS AT VARIOUS STAGES OF THE MITOTIC CYCLE. Gudkov, I. N.; Grodzinskii, D. M. (Inst. of Plant Physiology, Kiev). 1973. Translated from Radiobiologiya; 13: No. 5, 765-768(1973).

In Radiobiology.

Roots of pea seedlings synchronized with a 0.03% solution of hydroxyurea were exposed for an hour to solutions of the following radioprotectors at various times after synchronization: AET ($5 \cdot 10^{-4}$ M), MEA (10^{-3} M), ATP (10^{-4} M), and DNA hydrolyzate ($2 \cdot 10^{-4}$ %). Then the seedlings were irradiated at a dose of 800 rad. The degree of damage was estimated according to the survival of the root meristem. The protective action of AET and MEA was manifested to approximately equal degrees and was highest in the late G_1 period and in the S phase. The protective action of ATP was manifested to the greatest degree in the G_2 phase, that of DNA hydrolyzate in the G_1 and S phases. (tr-auth)

27007 (AEC-tr-7507, pp 160-163) POSSIBLE ROLE OF THIOLS IN THE DETERMINATION OF THE NATURAL RADIOSENSITIVITY OF DRY AND SWOLLEN SEEDS AND SEEDLINGS OF WHEAT POLYPLOIDS. Semerdzhyan, S. P.; Nor-Arevyan, N. G.; Grigoryan, Z. D.; Saakyan, A. G. (Scientific Research Inst. of Agriculture, Echmiadzin, USSR). 1973. Translated from Radiobiologiya; 13: No. 5, 771-773(1973).

In Radiobiology.

The radiosensitivity of dry and swollen seeds and two-week seedlings of various polyploid forms of wheat, evaluated according to the suppression of growth of the seedlings and the yield of chromosome aberrations, was studied. At the same time the content of SH groups in the embryos of dry and swollen seeds, as well as in meristem tissues of the seedlings, was investigated. It was established that only the dry seeds vary in radiosensitivity. A correlation of the radiosensitivity with the concentration of total SH groups was demonstrated. (tr-auth)

27008 (AEC-tr-7507, pp 187-192) CONTENT OF METALS IN CELL COMPONENTS OF PLANTS DIFFERING IN RADIORESISTANCE. Kulikov, B. N. (Inst. of Phytopathology, Tashkent, USSR). 1973. Translated From Radiobiologiya; 13: No. 5, 792-796(1973).

In Radiobiology.

A direct correlation was detected between the radioresistance of plants and the content of divalent metals in the bound form in their cellular structures. It was shown that DNA isolated from plants differing in radioresistance binds different amounts of metals. An attempt was made to substantiate the dependence found. (tr-auth)

27009 (AEC-tr-7507, pp 193-197) RESTORATION OF THE ACTIVITY OF IRRADIATED POTATO TUBERS UNDER THE ACTION OF FERRIC CHLORIDE. Gavrilov, Yu. S.; Serebrenikov, V. S.; Lipsits, D. V. (Scientific Research Inst. of Potato Farming, Korenevo, USSR). 1973. Translated From Radiobiologiya; 13: No. 5, 792-796(1973).

In Radiobiology.

In the γ irradiation of potato tubers at an inhibiting dose of 5 krad, ferric chloride (0.01 M) showed a distinct radioprotective effect only when already irradiated tubers were treated with it. In this case the germination of the tubers and growth of the sprouts were partially normalized, the number of chromosome aberrations induced by irradiation was lowered five-fold, the content of nucleic acids in the tissues of the eyes was significantly increased, and the incorporation of ^{59}Fe into the nucleic complex of the eyes was intensified. (tr-auth)

27010 (INIS-mf-745) CHANGES OF THE AMOUNT AND QUALITY OF PROTEIN IN MUTANT LINES OF SOFT WINTER WHEAT. Rachinski, Ts.; Dzhelepov, K. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 7p. (In Bulgarian). INIS.

From 2nd national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Investigations were carried out on 19 consolidated lines from the Caucasus, Aurora, and Bourgas 2 wheat varieties, selected according to morphologic characteristics in M_2 after irradiation with 10 and 15 kR gamma rays, which in preliminary analysis have shown a higher percentage of protein content. The samples were analyzed for content of crude protein, pure albumin, and fractional composition of the protein (albumins, globulins, and glutins). The samples were analyzed also with respect to the amount of irreplaceable amino acids: lysine, methionine and tryptophan. With respect to the crude protein content the mutants of the Caucasus variety exceed the initial variety by 1.2 to 2%, that of the Aurora variety by 1 to 3%, and that of the Bourgas variety by 2 to 1%. Similar trends of increase are established also in the pure protein and the fractional protein composition. The mutants 160/765 and 327/1337 manifested lysine content over 3% in the initial variety. (auth)

27011 (INIS-mf-751) POLLEN RADIOSENSITIVITY OF ATTAR-ROSE. Tsvetkov, R. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 13p. (In Bulgarian). INIS.

From 2nd national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

For breeding purposes of attar-rose, a study on gamma-radiosensitivity of fresh pollen was carried out. The following varieties of roses were utilized: R.damascena Mill., R.gallica, R.damascena bifera, R.damascena Aligar, R.simplex, R.canina, R.damascena (from Morroco), and Rose de Mai which are all widely utilized for breeding experiments. The following irradiation doses were applied: 0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.4, 0.6, 0.8, 1.0, 1.25, 1.5, 1.75, 2.0, 2.20, 2.4, 2.6, 2.8, 3.0, 3.2, 3.4, 3.6, 3.8 and 4.0 kR. Pollen vitality and fertility were investigated. In the diapason of gamma-radiation doses several lethal and stimulation gradients were established. With some of the species lethal doses were reached. Conclusions are drawn on the possibility of using pollen irradiation method in selection of attar-roses. (auth)

27012 (STI/PUB-339) INDUCED MUTATIONS IN VEGETATIVELY PROPAGATED PLANTS. Proceedings Series. Proceedings of a Panel on Mutation Breeding of Vegetatively Propagated and Perennial Crops Held in Vienna, Austria, September 11-15, 1972. (International Atomic Energy Agency, Vienna (Austria)). Nov 1973. 227p. (CONF-720935-). IAEA $10.00.

Separate abstracts were prepared for 10 of the 17 papers included. (CH)

For abstracts of individual papers see: 27013-27022.

27013 INDUCED MUTATIONS IN FRUIT TREES. Lapins, K. O. (Canada Dept. of Agriculture, Summerland, B. C.). pp 1-19 of Induced Mutations in Vegetatively Propagated Plants. Vienna; International Atomic Energy Agency (1973).

From symposium on mutation breeding of vegetatively propagated and perennial crops; Vienna, Austria (11 Sep 1972). See STI/PUB-339; CONF-720935-.

Induction of mutations in apple, apricot, and sweet cherry by γ irradiation complements a cross-breeding program. The objectives are the improvement of methods of induction, identification, and selection of useful mutations, and the initiation of useful mutations either for immediate use as improved cultivars or as parent material for conventional cross-breeding. Irradiated dormant or forced winter buds given favorable conditions for fast growth immediately following irradiation gave more mutations than did summer buds treated in August. Accessory buds of sweet cherry at an early ontogenetic stage provided little differentiated bud meristem as a target for irradiation. Moderate exposures, resulting in over 60% survival, gave high mutation frequencies. Buds 6 to 10 on the primary shoot gave higher frequencies of recognizable mutations than either buds 1 to 5 or 11 to 15. Mutants in tree growth differed greatly both in the characteristics to a very low percentage of the progeny. The creation of homogenous plants from chimeral compact mutants through the initiation of adventitious buds may provide breeding material capable of transmitting the compact growth type to its progeny. Partial gametic sterility was induced very frequently through irradiation. Genotypes of sweet cherry carrying a self-compatibility allele were used in crosses and resulted in the introduction of a self-compatible sweet cherry cultivar, Stella. A great majority of mutants affecting fruit was undesirable. Desirable mutants in apple included: mutants with reduced amount of russeting in fruit skin, mutants with reduced chlorophyll content in skin and flesh of fruit, and mutants with increased red color in fruit skin. An early maturing mutant of Blenheim apricot was named Early Blenheim. Challenging and promising prospects for using induced mutants in future tree fruit breeding lie in obtaining compact growth types in seeding progeny and in creating fully self-fertile genotypes in all fruit species. (auth)

27014 METHODS AND RESULTS OF MUTATION BREEDING IN DECIDUOUS FRUITS, WITH SPECIAL REFERENCE TO THE INDUCTION OF COMPACT AND FRUIT MUTATIONS IN APPLE. Visser, T. (Inst. for Horticultural Plant Breeding, Wageningen, Netherlands). pp 21-33 of Induced Mutations in Vegetatively Propagated Plants. Vienna; International Atomic Energy Agency (1973).

From symposium on mutation breeding of vegetatively propagated and perennial crops; Vienna, Austria (11 Sep 1972). See STI/PUB-339; CONF-720935-.

The induction of mutants in deciduous fruits, with special emphasis on apple, was realized by x ray treatment of dormant scions subsequently propagated on a rootstock in the nursery. The aim was to obtain compacts, presuming the feasibility of selecting compact shoots formed by the irradiated scions in the first vegetative generation and also assuming that chances of finding, e.g. fruit mutants would be thus increased rather than lessened. Selection was carried out on one-season-old shoots formed on the same material for two or three successive seasons, involving a cut-back at the end of the first and second season. The procedure followed was highly effective. It was estimated to be at least seven times more efficient as regards the output of compact apple clones in the orchard than the usual procedure, which entails the propagation of unselected shoots, postponing selection to the second vegetative generation. This difference in efficiency increases with a decrease in mutation frequency, such as in pears. Both procedures appear to be

equally efficient as regards finding normal clones with deviating, but more attractive fruits. A strong positive relation was found between the occurrence of growth and fruit mutations, but such fruit mutations more often constituted deteriorations than improvements. Decreased fruit size, a fairly frequently observed fruit anomaly, tended to be positively related to decreased leaf size. Also yield appeared to be often adversely affected, more so in compact than in normal-appearing clones, owing to both a quantitative and qualitative depressing effect of irradiation of flower development. The possibilities of mutation breeding are discussed, also in relation to those of cross-breeding. (auth)

27015 GAMMA-RAY MUTANTS IN APPLES. Zagaja, S. W.; Przybyla, A. (Research Inst. of Pomology, Skierniewice, Poland). pp 35-40 of Induced Mutations in Vegetatively Propagated Plants. Vienna; International Atomic Energy Agency (1973).

From symposium on mutation breeding of vegetatively propagated and perennial crops; Vienna, Austria (11 Sep 1972). See STI/PUB-339; CONF-720935-.

One-year old dormant shoots of eight apple cultivars were irradiated with a 2500 R dose of γ rays. During the first season following irradiation several abnormalities in leaf and shoot growth were observed; no shoots with shortened internodes were found, however. The shoots produced from irradiated buds were cut back to half their length. New shoots produced from lateral buds were harvested, in the dormant stage, and the length of their internodes was measured. Out of a total of 2943 shoots, 44 were found, in six cultivars, with significantly shortened internodes. Two cultivars produced no shoots with shortened internodes. The selected shoots were propagated on nursery stock. As was found later, only six shoots produced trees with shortened internodes, while all the others returned to a normal internode length. At the beginning of their third season of growth the irradiated scions were cleaned of all new wood to force new shoots from adventitious buds. Of 2783 shoots obtained from the adventitious buds, 53 shoots had shortened internodes. It is worth mentioning that, while in the first crop of shoots there was a wide range in degree of internode shortening, namely 10 to 45%, in the second crop the range of shortening of the internodes was much narrower, 17 to 23%. Recently a new experiment was begun to study the effect on mutation efficiency of both gamma-ray dose and the position of buds on the apple shoot. Preliminary results seem to indicate that, at least in some apple cultivars, the degree of injury of the buds by gamma rays depends not only on the dose but also on the position of the bud on the shoot. (auth)

27016 SUGAR-CANE IMPROVEMENT THROUGH INDUCED MUTATIONS USING VEGETATIVE PROPAGULES AND CELL CULTURE TECHNIQUES. Heinz, D. J. (Hawaiian Sugar Planters' Association, Honolulu). pp 53-59 of Induced Mutations in Vegetatively Propagated Plants. Vienna; International Atomic Energy Agency (1973).

From symposium on mutation breeding of vegetatively propagated and perennial crops; Vienna, Austria (11 Sep 1972). See STI/PUB-339; CONF-720935-.

A review of the use of induced mutations in the improvement of sugar-cane is presented. This includes the γ or x irradiation of vegetative propagules and cell suspensions. Cell culture techniques are described in relation to the use of chemical mutagens, and the advantages and disadvantages of various techniques are discussed. It is suggested the use of induced mutations in the improvement of sugar-cane might be an important adjunct to other breeding methods. (auth)

27017 METHODS FOR INDUCING MUTATIONS IN CASSAVA AND THE POSSIBLE USES OF THE MUTANTS. Moh, C. C.; Alan, J. J. (Inter-American Inst. of Agricultural Sciences, Turrialba, Costa Rica). pp 67-74 of Induced Mutations in Vegetatively Propagated Plants. Vienna; International Atomic Energy Agency (1973).

From symposium on mutation breeding of vegetatively propagated and perennial crops; Vienna, Austria (11 Sep 1972). See STI/PUB-339; CONF-720935-.

Because cassava can be propagated sexually as well as vegetatively, seeds, stem cuttings, and pollen can be irradiated as a method for mutation induction. While the efficiency of these methods for inducing mutations in cassava has not been thoroughly evaluated, pollen irradiation appears to have certain advantages. It eliminates the chimera production and allows an early evaluation of the mutated characters. Some mutants from pollen treatments were especially vigorous and many have value in the breeding program. Only two locations are known to have used mutation method for cassava breeding: India and Costa Rica. In India, yield improvement is the primary objective; in Costa Rica, cultivars of early root maturity and free of hydrocyanic glucosides are being sought. (auth)

27018 MUTATION BREEDING IN CITRUS. Spiegel-Roy, P.; Kochba, J. (Inst. of Horticulture, Bet Dagan, Israel). pp 91-103 of Induced Mutations in Vegetatively Propagated Plants. Vienna; International Atomic Energy Agency (1973).

From symposium on mutation breeding of vegetatively propagated and perennial crops; Vienna, Austria (11 Sep 1972). See STI/PUB-339; CONF-720935-.

Although natural mutants are widespread in citrus, few studies have been made so far on the artificial induction of mutations, largely because of the technical difficulties involved. A highly colored grapefruit mutant, Star Ruby, was obtained in Texas by irradiation with thermal neutrons. Several approaches for obtaining mutants are possible, e.g. budwood irradiation, use of nucellar embryos and regeneration of whole plants in vitro from ovules or ovule parts. In studies of Shamouti orange (Citrus sinensis) ovular callus, γ irradiation significantly stimulated embryoid formation from callus. Further lines of investigation include irradiation of callus on young decapitated stems, irradiation of excised ovules in vitro, as well as the more conventional methods of whole plant, budwood, and seed irradiation. Radiosensitivity was highest for young decapitated stems and lowest for ovular callus. Changes in leaf shape, especially an increase in the dimensions of petiole wing, were noted in MV_2 plants originating from γ-irradiated (7.5 kR) budwood. Some of the new methods developed, and especially those pertaining to the induction of plants in vitro, will be helpful in obtaining solid mutants in citrus. (auth)

27019 INDUCTION OF USEFUL MUTATIONS OF MULBERRY AND ROSES BY GAMMA RAYS. Nakajima, K. (Sericultural Experiment Station, Wada, Japan). pp 105-116 of Induced Mutations in Vegetatively Propagated Plants. Vienna; International Atomic Energy Agency (1973).

From symposium on mutation breeding of vegetatively propagated and perennial crops; Vienna, Austria (11 Sep 1972). See STI/PUB-339; CONF-720935-.

Acute γ irradiation from spring to summer proved to be most suitable and convenient from a practical point of view, compared with an acute irradiation in winter and the chronic one in general. Repeated cutting back of shoots after irradiation was effective for enhancing frequencies of non-chimeric mutation and mutation spectrum. Re-treating induced mutations with γ rays gave higher mutation frequencies and a wider mutation spectrum than when the original cultivars were irradiated; for example, in rose cultivar Peace, mutant flowers that had not appeared when Peace was irradiated were produced by the re-treatment. In mulberry, some useful mutant strains were selected, in particular, in connection with high leaf yield, and several mutants resistant to Dogare disease. In roses, mutants which originate from Peace and is characterized by deep yellow color, high-centred shape and pointed petals, and which were derived from a re-irradiated Peace mutant and show a very intense coloring along the flower edges, seem to be the most promising of many induced rose mutants. Cultivation trials concerning adaptability to climatically different regions are now in progress, using some of these mulberry and rose mutant strains. (auth)

27020 MUTATION BREEDING IN HEVEA BRASILIENSIS MUELL ARG. Ong Seng Haut; Subramaniam, S. (Rubber Research Inst. of Malaya, Kuala Lumpur). pp 117-127 of Induced Mutations in Vegetatively Propagated Plants. Vienna; International Atomic Energy Agency (1973).

From symposium on mutation breeding of vegetatively propagated and perennial crops; Vienna, Austria (11 Sep 1972). See STI/PUB-339; CONF-720935-.

Studies on mutation breeding in Hevea brasiliensis (Para rubber tree) are reviewed. An initial experiment with dormant green buds of a clone, RRIM 600, exposed to x rays in the dosage range of 1 to 8 krad was attempted. From this study, an exposure level of 2 krad appears to be the upper limit of survival for such dormant green buds. Green buds of seven other clones have been treated within the exposure range of 0.5 to 2 krad and a number of aberrant forms were observed on the V_1 shoots growing from the irradiated buds which were grafted on seedling stocks. A higher frequency of mutation was found on the V_2 shoots derived from the basal buds of the V_1 shoots than those from the higher buds. (auth)

27021 INDUCED MUTATIONS IN COFFEE. Moh, C. C. (Inter-American Inst. of Agricultural Sciences, Turrialba, Costa Rica). pp 129-136 of Induced Mutations in Vegetatively Propagated Plants. Vienna; International Atomic Energy Agency (1973).

From symposium on mutation breeding of vegetatively prop-

agated and perennial crops; Vienna, Austria (11 Sep 1972). See STI/PUB-339; CONF-720935-.

The coffee seed has an unusual biological response to radiations. When the seeds were irradiated, the mutant character appearing in the R_1 plants was not a chimeric change but the whole plant produced a similar mutant characteristic. Most of the mutations induced in the R_1 generation were morphological, especially the angustifolia (ag) type. That the ag frequency-dose relationship with thermal neutrons was linear and the relationship with γ or x rays was exponential suggests that the ag mutations were the results of two-hit chromosomal aberrations. The compact or semi-dwarf type of plant is a desirable character in coffee and probably also in other fruit trees. A mutant with compact character has been isolated from the irradiated population and this mutant is being tested in a field trial. (auth)

27022 MUTATION BREEDING IN CACAO (THEOBROMA CACAO L.). Opeke, L. K.; Jacobs, V. J. (Cocoa Research Inst. of Nigeria, Ibadan). pp 137-143 of Induced Mutations in Vegetatively Propagated Plants. Vienna; International Atomic Energy Agency (1973).

From symposium on mutation breeding of vegetatively propagated and perennial crops; Vienna, Austria (11 Sep 1972). See STI/PUB-339; CONF-720935-.

Cacao was introduced into West Africa about 100 years ago. Since then, several breeding projects have been carried out aiming at increased yield and commercial quality, drought resistance, and virus tolerance. A mutation breeding program was initiated in 1964, aiming primarily at the production of clones highly resistant to the black pod disease, Phytophthora palmivora. Cacao seeds and vegetative buds were irradiated with various doses of γ radiation. Irradiated seeds were sown and irradiated buds were grafted on standard rootstocks. Preliminary results reported include morphological changes in leaves of irradiated cultivars. (CH)

27023 INITIAL OBSERVATIONS OF THE EFFECTS OF GAMMA RADIATION ON OXYGEN CONSUMPTION, ^{32}P UPTAKE, AND PHYCOBIONT OF CLADONIA SYLVATICA (L.) HOFFM. Erbisch, F. H.; Kalosis, J. J. (Michigan Technological Univ., Houghton). Radiat. Bot.; 13: No. 6, 361-367(Dec 1973).

Observations of gamma-irradiated and non-irradiated podetia of Cladonia sylvatica (L.) Hoffm. with respect to oxygen consumption, ^{32}P uptake, and phycobiont damage indicated that the lichen was able to survive doses through 1000 krad for post-irradiation periods of at least 6 weeks. Physical damage, a slight browning of podetia, was noted immediately after doses of 2000 krad. No other macroscopic damage was noted at any of the other irradiation dosages. Oxygen consumption of the irradiated podetia paralleled that of the non-irradiated podetia indicating that the lichen survived the irradiation. Radiation damage was indicated by the reduced uptake of ^{32}P by podetia that had received 1000 krad. Phycobiont damage was noted 2 weeks after doses of 100 krad, and immediately after doses of 1000 krad and 2000 krad. However, less than 10% of the algal cells showed damage after the 6 week experimentation period. (auth)

27024 DIRECT AND INDIRECT EFFECT OF GAMMA IRRADIATION ON THE DIFFERENTIATION OF TOBACCO TISSUE CULTURE. Degani, N.; Pickholz, D. (Nuclear Research Center-Negev, Beersheba, Israel). Radiat. Bot.; 13: No. 6, 381-383(Dec 1973).

Tobacco tissue culture (Nicotiana tabacum var. Wisconsin No. 38) when grown on Murashige and Skoog medium readily developed leafy buds in light but not in darkness. When γ-irradiated over a range 0 to 5.0 Krad, the cultures differentiated in darkness too. Furthermore, the stimulus for differentiation in darkness could be transmitted to non-irradiated cultures by the irradiated medium. (auth)

27025 RESPONSE OF SHORTGRASS PLAINS VEGETATION TO GAMMA RADIATION. I. Chronic Irradiation. Fraley, L. Jr.; Whicker, F. W. (Colorado State Univ., Fort Collins). Radiat. Bot.; 13: No. 6, 331-341(Dec 1973).

Native shortgrass plains vegetation was exposed to chronic gamma radiation with exposure rates varying from 0.01 to 650 R/hr starting in April 1969. The dominant species in the plant community was Bouteloua gracilis (blue grama). Density and frequency were recorded and these data were converted into community indices of coefficient of community (CC) and diversity (D). The results indicated that the shortgrass vegetation was very resistant to ionizing radiation. 50% effects of CC and D resulted from exposure of 15 and 12 R/hr, respectively and had not significantly decreased further by June 1972. Community changes took place within constant CC and D values that resulted in the development of new communities and indicated a lack of sensitivity of these parameters for measuring community change and stability. One of the most resistant species was Lepidium densiflorum which became dominant at exposure rates of 12 to 28 R/hr. L. densiflorum was able to germinate, develop, and complete seed set at exposure rates greater than 28 R/hr. (auth)

27026 EFFECT OF CAFFEINE AND CYSTEINE APPLIED DURING POST-IRRADIATION HYDRATION ON AN OXYGEN-INDEPENDENT COMPONENT OF DAMAGE IN BARLEY SEEDS. Kesavan, P. (Jawaharlal Nehru Univ., New Delhi). Radiat. Bot.; 13: No. 6, 355-359(Dec 1973).

The modification of radiosensitivity of barley seeds with 11.1% water content by caffeine and cysteine applied during post-irradiation oxygenated and oxygen-free hydration was studied. No post-irradiation oxygen-dependent damage developed in these seeds. While cysteine had no influence at all, caffeine effectively potentiated the level of the gamma-induced oxygen-independent (Class I) component of damage. The possible reactivity of caffeine towards the precursors of the oxygen-dependent and -independent components of damage in determining the mode and magnitude of modification is briefly discussed. (auth)

27027 EFFECTS OF LOW DOSES OF GAMMA RADIATION ON THE GROWTH AND YIELD OF TWO VARIETIES OF TOMATO. Sidrak, G. H.; Suess, A. (Bayerische Landersanstalt fuer Bodenkultur, Pflanzenbau und Pflanzenschultz, Munich). Radiat. Bot.; 13: No. 6, 309-314(Dec 1973).

Seeds and 12-day old seedlings of both tall and dwarf varieties of tomato (Lycopersicon esculentum) were exposed to gamma radiation (250 to 2000 R) from a ^{137}Cs source and then grown under greenhouse conditions. Doses between 500 and 1000 R caused a significant increase in the weight of fruit yield of the two varieties. On the whole, the tall variety showed a greater degree of sensitivity to gamma radiation than did the dwarf variety. Irradiating dry seeds of the tall variety with doses of 250 to 1000 R caused early ripening of fruits manifested by pronounced increases in the number and weight of ripe fruits over the controls. The effect of radiation on the dry weight of 6-week old plants and the oxygen uptake by germinating seeds was similar to the response of fruit yield of plants derived from irradiated seeds. (auth)

27028 EFFECTS OF CHRONIC GAMMA IRRADIATION ON THE SOIL ALGAL COMMUNITY OF AN OAK-PINE FOREST. Franz, E. H.; Woodwell, G. M. (Univ. of Illinois, Urbana). Radiat. Bot.; 13: No. 6, 323-329(Dec 1973).

Populations of soil algae were sampled along the radiation gradient in the Brookhaven Irradiation Forest in the sixth year of irradiation. Seventeen taxa were identified from over 300 individual isolations. Changes in the soil algal populations were limited to the Devastated Zone from which most higher plants had been eliminated. Principal changes occurred at exposures in excess of 1000 R/day. Coefficient of community and percentage similarity dropped to 50% control of about 2250 R/day. Although diversity remained approximately constant or increased slightly at the highest exposures, there was a tendency toward replacement of eucaryotic forms by procaryotic forms at exposures in excess of 1000 to 2000 R/day. The soil algal community appeared to be more resistant than communities of higher plants and to have about the same sensitivity as the lichen community of the oak-pine forest. (auth)

27029 INHERITANCE AND LINKAGE RELATIONSHIP OF TWO RADIATION-INDUCED SEEDLING MUTANTS OF CUCUMBER. Whelan, E. D. P. (Canada Agriculture, Morden, Manitoba). Can. J. Genet. Cytol.; 15: No. 3, 597-603(Sep 1973).

A radioinduced mutation of cucumber (Cucumis sativus L.) which affects plant pubescence is controlled by a single recessive gene. Mutant seedlings have glabrous hynocotyls, and mature plants have glabrous internodes and leaf petioles. The laminae, especially of the first true leaf, the node areas, and the perianths are slightly pubescent (glabrate). This new gene is designated glb, glabrate. There was no evidence of linkage between this gene and glabrous (gl), non-bitter cotyledon (bi), light sensitive (ls), yellow cotyledon (yc) or crinkled-leaf (cr). A sister line of glb also segregated for a lethal mutation. Mutant seedlings had pale green, slightly smaller cotyledons, and died 6 to 7 days after emergence. The mutation was controlled by a single recessive gene, designated pl, pale lethal. The gene was not linked with either glabrate (glb) or non-bitter cotyledon (bi). (auth)

27030 CYTOLOGICAL INVESTIGATION OF THE EFFECTS OF GAMMA RADIATION ON COTTON SEEDS WITH PARTIAL REMOVAL OF THE DAMAGING EFFECTS. Atakuziev, S. (Inst. of General Genetics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 1, 46-47(1973). (In Russian).

The efficiency of the use of high and low temperatures for the partial reduction of the damaging effects of γ radiation was tested on air-dried cotton seed of 108-F and S-4727 varieties of Gossypium hirsutum L. The seeds were irradiated with doses of 10,

40, and 60 kR at doses of 610 R/min. The seeds were irradiated at −78°C, followed by wetting in distilled water for 5 min at 60°C and 1.5 hrs at 33 to 35°C. The cytological study showed that this processing partially reduced the damaging effects of radiation on the cells and significantly reduced the number of cells with chromosome rearrangement. (JSR)

27031 EFFECT OF GAMMA COBALT (γ ^{60}Co) RADIATION ON THE GROWTH AND ALKALOIDAL CONTENTS OF MEDICINAL PLANTS. Part I. Hyoscyamus Niger L. (Solanaceae). Malik, S.; Akram, M.; Shafiq-ur-Rehman; Malik, N. A. (PCSIR Labs., Peshawar, Pakistan). Pak. J. Sci. Ind. Res.; 15: No. 6, 384-385 (Dec 1972).

Henbane (Hyoscyamus niger) is cultivated for the biosynthesis of alkaloids, especially hyoscyamine, used by the pharmaceutical industry that are present in most plant parts, particularly in the leaves and flowering tops. Seeds of henbane were irradiated with doses of 1, 1.5, 2, 2.5, or 3 Krads γ radiation, and plants grown from the irradiated seeds were examined. The yield of leaves was increased by 60% and the content of hyoscyamine in the leaves was increased by 50% over that of control plants. Treatment of the seeds with doses of 1.5 to 2 Krad yielded the greatest amount of hyoscyamine. (CH)

27032 MODIFYING INFLUENCES OF GROWTH FACTORS ON RADIOINDUCED GROWTH STIMULATION AND INHIBITION IN LEMNA MINOR. Feldmann, A. (Kernforschungsanlage, Juelich, Ger.). pp 441-447 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Baden; Wiener Medizinische Akademie (1971). (In German).

From 1st European biophysics congress; Vienna, Austria (14 Sep 1971).

In Lemna minor x-ray induced growth stimulation and inhibition is modified to a high degree by light and temperature. Under sub- and transoptimal conditions of day length and temperature strong stimulation was obtained (number of fronds formed, fresh-, dry-, and ash-weights). Under optimal considerations only small stimulation effects were observed. Strong stimulation was linked with high threshold doses (1100 R, transition from stimulation to damage), weak stimulation with low threshold doses (400 R). These regularities, however, are only observable, if the irradiation is applied in the beginning of the photoperiod. The more the time of irradiation is shifted towards the end of the light phase the more the stimulation effects decrease. At the same time also the threshold doses decrease to about 20 R. In experiments, conducted under varying greenhouse conditions followed by a constant environment after irradiation of vice versa, the stimulation effects were generally reduced and in some cases again, the threshold doses were rather small. The reactions were influenced by the light and temperature conditions prior as well as after irradiation. Stimulating and depressing reactions, similar to those induced by x-rays, were also inducible by short changes of light and temperature conditions during a constant environment. The results indicate that the phytochrome system is involved with these reactions. (auth)

27033 MODIFICATIONS OF THE MEIOTIC PROCESS AS A FUNCTION OF THE GENETIC CONDITIONS. Bozzini, A. Inform. Bot. Ital.; 4: No. 1, 17-23(1972). (In Italian). (RT-BIO-(73)4).

Considerations of the genetic control of the meiotic process, with particular reference to chromosome synapsis, are briefly made; such an analysis derives particularly from data obtained by the description of a series of spontaneous or radioinduced mutations isolated in higher plants. (auth)

27034 RADIOSENSITIVITY OF PLANT SEEDS TO NEUTRONS AND ITS MODIFICATION. Gopal-Ayengar, A. R.; Rao, N. S.; Singh, B. B. (Bhabha Atomic Research Centre, Bombay). (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Neuherberg, Germany (22 Oct 1973).

Rice seeds were treated with 1% diethyl sulphate. This treatment reduced seed germination and plant survival. The percentage of germination as well as the survival of plants increased when the seeds were irradiated with increasing doses of thermal neutrons before chemical treatment. When rice and barley seeds were irradiated with thermal neutrons the damage (germination, survival, and height of seedlings) was not influenced by storage; on the other hand, storage influenced mutations and the number of chromosomal fragments. When barley seeds were irradiated with fast neutrons, storage enhanced the damage, the frequency of chromosomal aberrations was not affected by storage. The D_{50} values (seedlings high reduction) for fast neutrons for 12 crop plants varied from 0.66 krad to 6.13 krad, the RBE values decreased with the increase in D_{50} for neutrons. (GE)

Radiation Effects on Animals

Refer also to abstracts 28471 and 28684.

Man

Refer also to abstracts 26829, 26972, 27744, and 28475.

27035 TWENTY-FIVE-YEAR SURVIVAL OF SARCOMA BOTRYOIDES TREATED BY IRRADIATION. El-Mahdi, A. M.; Marks, R. Jr.; Thornton, W. N.; Constable, W. C. (Univ. of Virginia, Charlottesville). Cancer; 33: No. 3, 653-656(Mar 1974).

The case of a 26-year-old woman with a history of sarcoma botryoides of the vagina treated by radiation therapy at the age of 13 months is presented. The patient is free from local tumor recurrence or distant metastases. As a result of pelvic irradiation during her infancy, she has hypoplastic external genitalia, hypofunction of the ovaries, and infantile vagina and uterus. She has, however, normal urinary and bowel function. (auth)

27036 PANEL REPORT. Radiotherapy for Lung Cancer. Rubin, P. (Univ. of Rochester, NY). Cancer Chemother. Rep.; 4: No. 2, 311-315(Mar 1973).

Research programs designed to establish the most effective treatment schedule for lung neoplasms are reviewed, with emphasis on radiotherapy. It was concluded that the design of protocols should be to provide total therapy to all compartments of disease: local tumor, regional nodes, and distant metastases. Rather than a competitive approach as utilized in the past, each modality should be utilized as a reductive procedure of the tumor burden. As each treatment is combined effectively and efficiently in a logical sequence before the overt appearance of metastases occurs, increased tumor control and survival may eventuate. (auth)

27037 RADIATION THERAPY FOR CANCER OF THE LUNG: PREVIOUS EXPERIENCE AND DEFINITION OF CURRENT ISSUES. Perez, C. A. (Washington Univ., St. Louis). Cancer Chemother. Rep.; 4: No. 2, 145-152(Mar 1973).

In spite of numerous clinical trials, the management of patients with bronchogenic carcinoma remains a formidable challenge. Except for selected patients with very small peripheral tumors, few patients can be saved, even when the disease is diagnosed in an asymptomatic stage. In addition to a relatively high incidence of local or lymph node recurrence after surgical treatment or irradiation, the frequent development of distant metastases compounds the problem. The role of radiation therapy in the integrated management of bronchogenic carcinoma remains to be established. Pathologic examination of irradiated tumors and lymph nodes may contribute to this knowledge. The interrelationship between irradiation, surgical treatment, chemotherapy, and immunotherapy must be carefully investigated, and the effects of irradiation or drugs on the immune response of the patient should be evaluated. (48 references) (CH)

27038 RADIOLOGY NOW. 10-day-rule. Warrick, C. K. Brit. J. Radiol.; 46: No. 551, 933-934(Nov 1973).

Editorial comment is made on the "10-day-rule" resulting from the 1966 ICRP recommendation that in women of child-bearing capacity, non-urgent diagnostic radiography of the abdomen should be restricted to the pre-ovulatory phase of the menstrual cycle. These recommendations were reinforced in 1972 in the U. K. by the Code of Practice for the Protection of Persons against Ionizing Radiation arising from Medical and Dental Use (H.M.S.O. 1972). Attention is drawn to the risk of increased incidence in childhood malignancies, as well as the possible effects of radiation on the maturation of the embryo. It is pointed out that hospital surveys are useful, not only with respect to the extent to which the rule is being applied, but in collecting information on the methods and difficulties of implementing the rule. (UK)

27039 HAZARDS FROM THE INDUSTRIAL USE OF RADIOACTIVE STATIC ELIMINATORS. Robertson, M. K.; Randle, M. W. (National Radiation Lab., Christchurch, N. Z.). Health Phys.; 26: No. 3, 245-250(Mar 1974).

A brand of air ionizing device for the elimination of static electricity was subjected to tests to determine any possible hazards from the release of radioactive material in industrial use. It was found that a severe hazard could arise from the inhalation of crushed radioactive particles that could be readily released. A lesser hazard is possible from the ingestion of free radioactive material, which may also be readily released. The use of these static eliminators in New Zealand was made subject to stringent control. (auth)

27040 EFFECTS OF RADIATION ON CARDIAC SHADOW. Ohata, T.; Watanabe, T.; Kasuga, T. (Shinshu Univ., Nagano,

Japan). Rinsho Hoshasen; 18: No. 12, 947-954(Nov 1973). (In Japanese).

Effects of irradiation on the heart were roentgenologically examined in 113 patients with cancer of the esophagus, 22 with cancer of the cardia, and 103 with cancer of the breast. Anterior and posterior two fields irradiation with tele-^{60}Co was performed in the patients with cancer of the esophagus and the cardia. Tumor dose of radiation was more than 4000 rads, and over one-third of the heart was included in the irradiation field. The size of irradiation field was less than 80 cm^2 in 77 patients, 80 cm^2 to 100 cm^2 in 31 patients, and more than 100 cm^2 in 18 patients. In the patients with cancer of the breast, tele-^{60}Co was irradiated to the supra- and sub-clavicular fossa and over 2000 rads of 200 kVp x ray was irradiated to the chest wall. Forty to 100% of the tumor dose was irradiated to the heart. In three patients with cancer of the esophagus or the cardia, the cardiac shadow was changed during the period of the treatment, showing acute pericardiac effusion. Of them, one patient was complicated with pleural effusion. Irradiation field of these three patients was more than 100 cm^2. Radiograms of 62 patients were examined for 3 months after the treatment was finished, and acute secositis was found in one patient. In two patients out of 10 cases followed for 1 year, enlargement of the cardiac shadow was observed. Irradiation fields of these were less than 80 cm^2 or more than 100 cm^2. No patient with cancer of the breast showed changes in the cardiac shadow during the period of treatment. However, 78 patients, including 38 cases with cancer of the right breast and 40 cases with cancer of the left breast, were followed up for 6 months and in two cases with cancer of the left breast radiation pneumonia was found, and at the same time the findings of acute pericarditis was also showed. Radiograms of 38 patients, including 17 cases with cancer of the right breast and 11 cases with cancer of the left breast, were followed up for over 4 years, and one case with cancer of the right breast caused cardiac collapse and a sudden death due to myofibrosis of the heart. In addition, the radiograms of four cases were demonstrated in this report. (JA)

27041 PROGNOSIS OF IRRADIATED CARCINOMA OF CERVIX UTERI AND NUCLEAR DNA IN CYTOLOGIC POSTIRRADIATION DYSPLASIA. Okagari, T. (Univ. of Minnesota, Minneapolis); Meyer, A. A.; Sciarra, J. J. Cancer; 33: No. 3, (Mar 1974).

The authors examined 222 cytologic specimens from 60 patients with squamous cell carcinoma of the cervix, International Stages II and III, who were treated with radiation. When evidence of postirradiation dysplasia (PRD) was found, the nuclear DNA content of the dysplastic cells was measured by two-wavelength Feulgen microspectrophotometry, with 20 morphologically normal intermediate squamous cells used as controls. On the basis of these measurements, occurrences of PRD were classified as diploid, polyploid, or aneuploid. Types of PRD were correlated with 5-year rates of recurrence of disease. The incidence of PRD, especially of the aneuploid type, was significantly higher in women who died within 5 years. Six of seven women with cytologic evidence of the aneuploid type of PRD had recurrent disease within 2 years. The data suggest that microspectrophotometry of cytologic samples might contribute to early detection of recurrent malignant disease, especially in patients who show evidence of aneuploid postirradiation dysplasia. (auth)

27042 CONSIDERATIONS ON SOME ALTERATIONS OF THE VISUAL FUNCTION WHICH CAN REDUCE THE FITNESS FOR NUCLEAR WORK. Strambi, E. (CNEN, Rome). Securitas; 57: No. 8-9, 703-707(1972). (In Italian). (RT/PROT-(73)6).

Some minor alterations of the visual function which may cause a restruction of the physical adaptibility for radiation work are discussed. In this connection, the nuclear activities that require special visual adaptibility and the activities bearing special risks for injuries of the eye are considered separately. (auth)

27043 HISTOPATHOLOGIC AND HISTOCHEMICAL CHANGES IN HUMAN SKIN AFTER X-RAY THERAPY IN SINGLE AND FRACTIONATED DOSES. Wozniak, L.; Olecki, A.; Studencki, E.; Pluta, J. (Medical Academy, Lodz, Poland). Patol. Pol.; 23: 515-523(1972). (In Polish).

Skin samples of persons irradiated for carcinoma of the skin were studied histologically and histochemically. Comparison of the effect of fractionated and single doses of x radiation did not show any significant differences. The histopathologic and histochemical changes in the epidermis and corium three months after irradiation were characterized. (auth)

27044 OCCUPATIONAL EXPOSURE TO X RAYS IN THE YEARS 1966-1970. Jankowski, J.; Krych, B. (Inst. of Occupational Medicine, Lodz, Poland). Pol. Przegl. Radiol. Med. Nukl.; 36: 637-643(1972). (In Polish).

Results are reported from measurements of the individual doses received by persons with occupational exposure to x-rays in Poland. The measurements were performed using dosimetric films for 14,760 persons. The results of this study carried out in the years 1966 to 1970 showed a systematic rise in the number of persons with exposure not exceeding 400 mR annually, i.e. $^1/_{12}$ of the admissible annual dose. In 1970 the group accounted for 98.3% of all studied subjects. A systematic decrease was found also in the number of persons in whom the three-month or yearly doses had been exceeded. In 1970, 30 cases were recorded in which the admissible three-month dose had been exceeded, and 9 cases with admissible yearly doses exceeded. In all these cases, with one exception, the admissible three-month or annual dose had been exceeded within one month. It was concluded that radiation protection practices in radiological laboratories are good and only accidental breaching of the work rules occur. (auth)

27045 OSTEOGENOUS SARCOMATA INDUCED BY IRRADIATION. Kolar, J.; Bek, V. (Charles Univ., Prague). Cesk. Radiol.; 27: No. 1, 69-72(Jan 1973). (In Czech).

Two cases are reported confirming the carcinogenic effect of ionizing radiation: osteoplastic sarcomata formed as a result of radiotherapy of retinoblastoma and of Wilms' tumor, respectively. The second case is believed to be the fifth reported case in the world of the sarcoma resulting from the radiotherapy of nephroblastoma. (Nuclear Sci. Abstr. Czech.)

27046 RADIATION OVEREXPOSURE OF AN INDUSTRIAL RADIOGRAPHER. Mullarkey, D. T. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 6, 16-17(Jan 1974).

A brief case report is presented of an overexposure of an industrial radiographer employed to ensure satisfactory welding of tubes manufactured from steel sheet. The film dosemeter worn on the chest recorded a dose of 4.8 rem, and the NRPB, asked to estimate finger dose, concluded that this was about 400 rem. The situation arose because the radiographer did not carry out approved operating procedures. The ^{192}Ir source, (activity about 8 Ci), was mounted in a torch exposure device that should have been used in a saddle device attached to the outside of the tube under inspection. A saddle was not available and the torch was inadequately modified by the operator and taken inside the tubes to be inspected. (UK)

27047 RADIATION DANGER IN THE INDUSTRIAL USE OF THORIATED ELECTRODES. Elovskaia, L. T. Avtomat. Svarka; No. 12, 60-65(1962). (In Russian).

A review of the radiation hazards involved in the use of thoriated tungsten electrodes for the manual, automatic, or semi-automatic argon- or helium-shielded welding: contamination of the air in the respiratory zone and at the fume emission point and contamination of various surfaces under the worst possible conditions. The author concludes that there is no radioactive-contamination hazard provided the electrode consumption in a specific shop does not exceed a given level. (Occup. Saf. Health Abstr.)

27048 PRELEUKEMIC STATE IN ATOMIC BOMB SURVIVORS, WITH SPECIAL REFERENCE TO RETRO- AND PROSPECTIVE ANALYSIS. Kamada, N.; Uchino, H. (Research Inst. for Nuclear Medicine and Biology, Hiroshima). Rinsho Ketsueki; 13: No. 3, 313-322(Jun 1972).

Hematologic and cytogenetic studies were made on five leukemia patients who had a history of atomic bomb exposure and blood disorders such as anemia and/or leukopenia for 5 or 13 years preceding the terminal development of acute leukemia (the first group). Of the 5 cases, 3 were exposed within 1,000 meters from the hypocentre. Hematologically abnormal characteristics in the preleukemic stage in these cases were anemia (all cases, 5/5), monocytosis (4/5), prolonged leukopenia for over 10 years (4/5), appearance of erythroblasts in the blood one to 5 years prior to the development of leukemia (4/5), erythroid hyperplasia in bone marrow (3/5), maturation arrest in the granulocyte series (3/5), and presence of abnormal mitosis resulting in bi-nucleated immature granulocytes in bone marrow and its maturation forms in blood (3/5). Chromosome aberrations were observed in 4 of the 5 cases in the period before their leukemia became overt clinically. There were 5 other cases with anemia (sideroblastic, PNH, and aplastic) which had chromosome aberrations in the bone marrow cells but were not diagnosed as leukemia (the second group). Furthermore, five heavily irradiated persons were presented who had abnormal chromosomes with some clones in their marrow cells without any clinical complaints (the third group). Morphologically abnormal characteristics, especially the presence of bi-nucleated immature granulocytes, and bone marrow chromosome aberrations in the preleukemic stage were discussed in terms of leukemogenesis following radiation exposure. (auth)

27049 PRELEUKEMIC STATUS IN ATOMIC BOMB SURVIVORS, ESPECIALLY RELATIONSHIP WITH APLASTIC ANEMIA. Michito, I. (Nagasaki Univ., Japan). Rinsho Ketsueki; 13: No. 3, 335-337(Jun 1972). (In Japanese).

Review of the data accumulated at Nagasaki University and ABCC during the past 20 years revealed 156 cases of aplastic anemia. The risk of aplastic anemia among atomic bomb survivors did not show a statistically significant increase. Two cases of acute leukemia among proximally exposed survivors showed a temporary severe decrease of leucocyte count immediately following atomic bomb explosion. Eight cases of specific anemia among proximally exposed persons during about 1949 to 1955 were discovered. These cases showed pancytopenia of peripheral blood and blast cell focus in some cases or acute myelofibrosis in other cases in bone marrow. It seems that the bone marrow of atomic bomb survivors who were exposed to heavy doses of radiation was one of preleukemic status. (auth)

27050 RADIOBIOLOGICAL PRINCIPLES OF THE APPLICATION OF IONIZING RADIATIONS TO MAN WITH REGARD TO THE EFFECT OF LOW DOSES: GENETIC EFFECTS. Stephan, G. (Bundesgesundheitsamt, Neuherberg, Ger.). (1973). vp. (In German).

From fourteenth annual meeting of the Vereinigung Deutscher Strahlenschutzaerzte eV; Wuerzburg, Germany (16 Nov 1973).

The increasing radiation exposure of the population resulting from the use of artificial radiation sources, especially in the medical field, called for thorough investigations of the genetic radiation effect. One of the prime issues is the definition of the threshold value, i.e. of the lowest dose that will most probably induce gene mutations. The main difficulty here is to obtain unambiguous and statistically verified results by means of experiments in the range of low doses. The results obtained so far do not present a uniform picture and there are some experiments that rather point to a linear dose-response relationship without a threshold value. The various types of mutations such as point, chromosomal, and genome mutations are described along with the corresponding formation mechanisms. The currently applied methods of evaluating the genetic hazards to man of ionizing radiations and the doubling dose which is based on animal experiments are outlined and discussed. (GE)

27051 EFFECT OF THERAPEUTIC IRRADIATION ON SERUM PROTEINS IN PATIENTS WITH CARCINOMA. Simsa, J.; Chvojka, Z.; Janousek, Z.; Mraz, J. (Purkyne Medical Research Inst., Hradec Kralove, Czech.). Radiobiol.-Radiother.; 14: No. 6, 643-649(1973).

Using the method of radial immunodiffusion, the levels of 10 serum proteins were studied in the group of 14 patients with gynecological indications (during treatment by ^{60}Co ionizing irradiation). As controls a group of 20 healthy woman blood donors (aged 41 to 61 years) was used. During irradiation, no significant changes in the concentrations of the investigated proteins were found. The concentrations of haptoglobin and ceruloplasmin in patients were significantly higher before irradiation than in controls. We suppose that radiation damage of the organism was small in our experiments, so that no changes could appear in the levels of analyzed proteins during treatment. Only in the case of transferrin and IgG was found statistically insignificant decreased levels. (auth)

27052 MATHEMATICAL MODEL OF CHANGING INFLUENCE OF SOME FACTORS ON THE BIOLOGICAL EFFECT OF IONIZING RADIATION. Vintenberg, E. I.; Guseva, N. I.; Karnauchova, E. N. (Inst. for Experimental and Clinical Oncology, Tallin). Radiobiol.-Radiother.; 14: No. 6, 677-687(1973). (In German).

Skin response to irradiation is determined by the disturbance of hair follicles by quantitative assessments according to 6-point evaluation system that was used for the algorithm for the determination of doses of combined irradiation being equivalent with respect to damaging effect. By means of algorithm calculation dependences of combined irradiation dose for some combinations of reference irradiation dose were obtained. Additionally, continuous dependences of quantitative assessments of damaging degree of the reference irradiation dose were obtained. Some iteration cycles of serial precision of the above described dependences led to their greater reliability. Each plot was made up in the basic nomogram obtained by the algorithm, corresponding to parameters being coefficients of change to the extent of damaging effect in the transition from certain experimental conditions to other ones. Completion of the system with these parameters facilitated the construction of a mathematical model that is a description of main dependences with polynoms of 2nd degree on the basis of the minimum of mean square error using a central programming in 3 planes. By means of this model and some additional dependences, the determination of equivalent irradiation doses for already examined effects and the determination of doses of combined effect yielding the necessary biological effect are possible on the basis of an optimum programming according to old or new models. (auth)

27053 PATHOLOGY AND TREATMENT OF POSTIRRADIATION ENTERITIS. Ciger, J. (Fakultni Nemocnice, Kosice, Czech.); Hildebrand, T.; Rychlo, A.; Bardos, L.; Cichy, A. Vnitr. Lek.; 19: No. 8, 800-807(Aug 1973). (In Slovak).

Two cases are described of postirradiation enteritis accompanied with the malabsorption syndrome. Discussed are the symptomatology, diagnostics, clinic, pathology, and histology of the intestinal changes involved as well as the principles of internal and surgical treatment. A review is made of postirradiation enteritis incidence reported in literature. (INIS)

27054 EFFECTS OF LOW-DOSE PRENATAL IRRADIATION IN HUMANS: ANALYSIS OF CHICAGO LYING-IN DATA AND COMPARISON WITH OTHER STUDIES. Oppenheim, B. E.; Griem, M. L.; Meier, P. (Univ. of Chicago). Radiat. Res.; 57: No. 3, 508-544(Mar 1974).

A prospective long-term follow-up study of about 1000 firstborn children exposed in utero to diagnostic pelvimetry examinations, along with suitable controls, was carried out. In other studies, x-ray examinations were always prompted by some medical indication; in the present study, the examinations were obtained on a routine basis. Data on all significant illnesses and hospitalizations were collected and analyzed, and no conclusive evidence of a radiation effect was found. A statistically significant discrepancy exists between the results of the present study and that of Diamond and Lilienfeld regarding the death rate from all causes for white children exposed to diagnostic x-rays in utero. Discrepancies also exist between the results of earlier studies of in utero or preconception exposure to diagnostic x-rays on the one hand, and atomic bomb radiation on the other hand, with regard to the rate of incidence of leukemia or other forms of cancer, Down's syndrome, the sex ratio of offspring, and the death rate from all causes. This suggests the possibility that the various reported effects of prenatal exposure to diagnostic x-rays might have been due not to the exposure, but rather to the result of biasing factors introduced by the selection of irradiated subjects on the basis of medical indication. (auth)

27055 DETERMINING OPTIMUM DOSE–TIME–AREA RELATIONSHIPS IN CURATIVE RADIOTHERAPY OF CANCER. A Review and Evaluation. Fichardt, T. (H. F. Voerwoerd Hospital, Pretoria). S. Afr. Med. J.; 47: 1070-1080(23 Jun 1973).

The old and vital problem of optimum dosage determination in radiotherapy of cancer is reviewed in chronological order from empirical to mathematical concepts. The magnitude of the problem is explained. Doubt is expressed whether a mathematical formula will ever be found that could safely predict an optimum dose-time-area relationship and that could be applied with impunity to the particular patient, without fear of radiation damage to the normal tissues involved. The use of Strandqvist mathematical formula and iso-effect curves and dose-time-area tables representing normal tissue tolerance effects for orthovoltage and telecobalt therapy was evaluated based on experience with patients treated over the past decades. These tables are used as a guide in planning a treatment schedule for a particular patient, but optimum treatment is determined on clinical grounds, on the reactions of the normal tissues, the response of the tumor, and the condition of the patient, and treatment is stopped when the normal tissues have reached tolerance, irrespective of whether the treatment schedule has been completed or not. (auth)

27056 PROBLEMS IN THE PREVENTIVE SUPERVISION OF RADIATION WORKERS IN A LARGE MEDICAL INSTITUTION. Dror, K.; Stampler, H. pp 100-107 of Proceedings of the Sixth National Conference of the Israel Health Physics Society. Schlesinger, T. (ed.). Yavne, Israel; Israel Health Physics Society (1972). (In Hebrew).

From 6th national conference of the Israel Health Physics Society; Nhal, India (19 Dec 1971).

Voluntarily preventive supervision of radiation workers in Israel (x ray diagnosis and therapy, radioisotopes) was instigated as soon as a film badge service became available. The effectiveness of the program is discussed. (CH)

27057 CASE OF RADIATION-INDUCED PENILE AND SCROTAL ELEPHANTIASIS WITH DAMAGE TO THE CORPORA CAVERNOSA. Wrobel, S.; Perkowski, J. Pol. Przegl. Chir.; 45: 917-919(Jun 1973). (In Polish).

The authors describe a patient with penile and scrotal elephantiasis and radiation-induced lesions in the corpora cavernosa demonstrated by cavernosography. (auth)

27058 CLINICAL TESTING OF THE PREPARATION CYSTAPHOS (MONOSODIUM SALT OF BETA-AMINOETHYL THIO-

PHOSPHORIC ACID). Telicenas, A.; Karosene, E. Radiobiol.-Radiother.; 14: No. 6, 671-676(1973). (In German).

The results of clinical testing of the radioprotective substance cystaphos (monosodium salt of beta-aminoethyl thiophosphoric acid) is represented. The preparation was administered to mamma carcinoma and portio carcinoma patients before the irradiation period. The data obtained showed symptoms of a general radiation reaction as to nausea, headache, sleeplessness, and so on to occur much more seldom among patients having received cystaphos. The preparation had no protective influence on the development of radiation leukopenia with radiation therapy, it guaranteed, however, a more rapid regeneration of the whole leukocyte amount after termination of the treatment compared with the starting values existing before irradiation. Radiation leukopenia developed to the same extent in patients having received cystaphos and in patients without uptake of cystaphos. The radioprotective substance obviously protected thrombocytes against the injurious effect of ionizing radiation. In patients having received cystaphos, a thrombocytopenia did not develop during radiation therapy that was characteristic of the control patients, i.e., who were treated without the radioprotective substance. The regression of the tumorous process under the influence of radiation therapy was the same in patients without its uptake. (auth)

27059 ALVEOLAR MACROPHAGE AND ITS ROLE IN TOXICOLOGY. Bowden, D. H. (Univ. of Manitoba, Winnipeg). CRC Crit. Rev. Toxicol.; 2: 95-124(Jun 1973).

The role of alveolar macrophages in toxicology is reviewed. The macrophage is discussed with regard to its origin, morphology, metabolism, relationship to lung alveoli, and relationship to pulmonary clearance. The toxic effects of inhaled particulate pollutants and the phagocytic functions of macrophages are discussed with regard to silica, asbestos, and allergenic dusts. The impairment of the defensive functions of alveolar macrophages by gaseous pollutants such as ozone, sulfur dioxide, and tobacco smoke, is reviewed. Following whole-body or local irradiation increased susceptibility to infection occurs and the macrophages play an important role in defending the alveolar wall against bacterial invasion. It is thought that the macrophages are relatively radioresistant. The health hazards of inhaled radioactive aerosols such as polonium and plutonium compounds are pointed out and the role of macrophages in phagocytosis and clearance of inhaled particles from the lungs is discussed. The responses of lung tissues to drugs and hormones are described and the relationship of macrophages to these responses is reviewed. (241 references) (HLW)

Vertebrates

Refer also to abstracts 26963, 26986, and 27136.

27060 (AEC-tr-7507, pp 30-36) MATHEMATICAL DESCRIPTION OF THE DYNAMICS OF THE TOTAL CELL CONTENT IN THE HEMATOGENIC TISSUE OF IRRADIATED AND PROTECTED MICE. Semenov, D. I.; Tarakhtii, E. A. (Inst. of the Ecology of Plants and Animals, Sverdlovsk, USSR). 1973. Translated From Radiobiologiya; 13: No. 5, 674-679(1973).

In Radiobiology.

The dynamics of change in the cell content of the bone marrow, spleen, and inguinal lymph nodes in mice after total γ irradiation at $LD_{75/30}$ and protected with cysteine is described by the sum of two exponential and logistic functions. In this case tissue differences are detected in the rate of destruction, recovery, as well as in the degree of protection by cysteine (changes in the initial level of recovery and its rate). (tr-auth)

27061 (AEC-tr-7507, pp 64-68) STATE OF THE RAT INTESTINE UNDER CONDITIONS OF TOTAL INFLUENCE AND LOCAL IRRADIATION OF IT AT DOSES CAUSING DEATH OF THE ANIMALS WITHIN 3.5 TO 5 DAYS. Fedorovskii, L. L. (Inst. of Biophysics, Moscow). 1973. Translated From Radiobiologiya; 13: No. 5, 700-703(1973).

In Radiobiology.

The functional state of the rat intestine was studied after total (at a dose of 1050 R) and local x irradiation (at a dose of 2200 R), causing death of the animals within 3.5 to 5 days. The same degree of inhibition of the incorporation of ^{14}C-glycine into the protein of the duodenal mucosa and the enzyme-secreting function of the intestine was established. A substantially more pronounced increase in the permeability of the vessels of the intestine to ^{51}Cr-albumin and a decrease in the hematocrit were detected in the case of local irradiation. (tr-auth)

27062 (AEC-tr-7507, pp 77-82) RADIOPROTECTIVE EFFECTIVENESS OF THE ADENOSINE–TRIPHOSPHATE SALT OF β-MEA (CYTRIPHOS). Pantev, T.; Bokova, N.; Nikolov, I.; Rogozkin, V. D.; Sbitneva, M. F.; Chertkov, K. S. (Inst. of Radiology and Radiation Hygiene, Sofia). 1973. Translated From Radiobiologiya; 13: No. 5, 709-712(1973).

In Radiobiology.

The adenosinetriphosphate salt of β-MEA was synthesized. Its intraperitoneal administration to mice in a dose of 750 mg/kg 20 min before irradiation at an absolutely lethal dose protects 65% of the animals from death. The protective properties of cytriphos are manifested both in the case of brief irradiation, taking several minutes, and in the case of the prolonged influence, lasting about 4 hrs. The administration of cytriphos after irradiation increases the mortality of the treated mice. (tr-auth)

27063 (AEC-tr-7507, pp 83-89) RADIOPROTECTIVE EFFECT OF MEXAMINE AND CYSTAPHOS AGAINST THE EPILATING ACTION OF IONIZING RADIATIONS. Vatsek, A.; Pospishil, M.; Rakova, A. (Inst. of Biophysics, Brno). 1973. Translated From Radiobiologiya; 13: No. 5, 713-718(1973).

In Radiobiology.

The protection of the fur of young mice from the epilating action of ionizing radiation was investigated. When cystaphos was used, the protective action against epilation was observed only after subcutaneous injection, whereas mexamine provided protection both after subcutaneous and after intraperitoneal injection. In the case of intraperitoneal injection of mexamine there was a general protective effect; after subcutaneous injection (depending on the amount of mexamine), a general or local protective effect was found. The nature of the protective action of mexamine is directly associated with the state of tissue hypoxia that it induces. The combined use of mexamine and cystaphos lengthens the protective effect to 120 min, whereas cystaphos and mexamine individually protected only for 30 min. (tr-auth)

27064 (AEC-tr-7507, pp 90-94) RADIOPROTECTIVE ACTION OF MEXAMINE IN THE CASE OF PERORAL ADMINISTRATION IN MONKEYS. Trushina, M. N.; Znamenskii, V. V.; Chernov, G. A.; Lemberg, V. K. (Inst. of Biophysics, Moscow). 1973. Translated From Radiobiologiya; 13: No. 5, 719-722 (1973).

In Radiobiology.

Peroral administration of mexamine to monkeys in an amount of 75 mg/kg 15 min before γ irradiation at a dose of 620 R at a dose rate of 29.6 R/min, followed by treatment with vitamins and antibiotics, increased the survival of the irradiated animals to 50%, as against 70% death in the control, and also promoted a more active recovery of the leukocytes, reticulocytes, and thrombocytes. (tr-auth)

27065 (AEC-tr-7507, pp 102-108) DOSE DEPENDENCES OF THE INJURIOUS ACTION OF WHOLE-BODY AND LOCAL BETA IRRADIATION. Moskalev, Yu. I.; Shelesnova, V. I.; Milovidova, I. A.; Reitarovskii, I. K. (Inst. of Biophysics, Moscow). 1973. Translated From Radiobiologiya; 13: No. 5, 729-733(1973).

In Radiobiology.

The influence of various doses (from 600 to 7200 rad) of the β rays of $^{90}Sr-^{90}Y$ on the lifetime, frequency and rate of development of tumors of the mammary glands and skin, and cataract after external irradiation of the whole body, its anterior or posterior half, was investigated in an experiment on 475 white rats. The values of the acute, subacute, and chronic effective doses for various conditions of irradiation were established. Whole-body β irradiation and irradiation of the anterior half of the body proved most effective. Tumors of the mammary glands and skin were detected almost exclusively in the irradiated portions of the body. Radiation cataracts developed in proportion to the dose only in the case of irradiation of the whole body and its anterior half. (tr-auth)

27066 (AEC-tr-7507, pp 109-114) COMPARATIVE ANALYSIS OF THE THERAPEUTIC ACTION OF NATIVE, DENATURED, AND HYDROLYZED DNA. Pryabchenko, N. I.; Ivannik, B. P.; Konoplyannikov, A. G.; Murzaev, V. I. (Inst. of Medical Radiology, Obninsk, USSR). 1973. Translated From Radiobiologiya; 13: No. 5, 734-738(1973).

In Radiobiology.

An analysis was made of the therapeutic action of native, denatured, and hydrolyzed (0.2 N HCl, 100°C, 20 min) DNA on the survival of mice irradiated with γ rays at doses of 700 to 800 rad at a dose rate of 43.4 rad/min. Intraperitoneal injection of 0.6 mg DNA 24 hrs after irradiation of the animals increased their survival rate by 80%. No differences were found in the therapeutic action of native, denatured, and hydrolyzed DNA. (tr-auth)

27067 (AEC-tr-7507, pp 115-118) INFLUENCE OF CERTAIN WATER-SOLUBLE VITAMINS ON PROCESSES OF OXIDATIVE PHOSPHORYLATION IN THE LIVER MITOCHONDRIA OF

IRRADIATED RATS. Alferov, A. N. (Kiev Roentgenoradiological and Oncological Scientific Research Inst.). 1973. Translated From Radiobiologiya; 13: No. 5, 738-741(1973).

In Radiobiology.

The subcutaneous injection of vitamins B_1, P, and PP into animals before irradiation with x rays (600 R) promoted a normalization of the energy metabolism in the liver mitochondria of the irradiated animals. Vitamins B_2 and C, administered to the animals before irradiation, inhibited processes of oxidative phosphorylation in the irradiated animals. Vitamins B_1, B_2, P, and PP, administered to the animals after irradiation, had a favorable influence on the indices of the energy metabolism in liver mitochondria. Vitamins B_2 and C, administered to irradiated animals, did not influence the energy metabolism of the irradiated animals. At lethal doses of irradiation (900 R), the vitamins had no significant influence on oxidative phosphorylation in the liver mitochondria of irradiated animals. (tr-auth)

27068 (AEC-tr-7507, pp 133-137) THIN LAYERS OF NUCLEAR MEMBRANES AND THE EFFECTS OF uv RADIATION ON THEM. Tongur, A. M.; Volkova, M. S.; Pavlovskaya, T. E. (Inst. of Biochemistry, Moscow). 1973. Translated From Radiobiologiya; 13: No. 5, 750-754(1973).

In Radiobiology.

The surface properties and permeability of nonirradiated films of nuclear membranes and films irradiated with uv rays, 254 mμ, isolated by a gradient method from calf thymus cell nuclei, were studied. The fine topography with small and large pores 100 to 1000 Å in diameter was detected by the method of electron microscopy of films of nuclear membranes, maximally stretched out on 2 M NaCl. The films of nuclear membranes possess highly elastic properties. The action of uv rays in a dose of $1.2 \cdot 10^7$ erg/mm^2 negligibly changes their surface properties and permeability, which is evidently associated with the unique structure and nature of the nuclear membranes. (tr-auth)

27069 (AEC-tr-7507, pp 157-159) INFLUENCE OF THE RADIOSENSITIZER PARA-CHLOROMERCURYBENZOATE ON THE LEVEL OF PROTEIN THIOLS IN HEMATOGENIC TISSUE AND THE POSTRADIATION SURVIVAL OF MICE. Dontsova, G. V.; Smirnova, I. B. (Inst. of Developmental Biology, Moscow). 1973. Translated from Radiobiologiya; 13: No. 5, 769-771(1973).

In Radiobiology.

The question of the role of thiols in radiosensitization was investigated. It was shown that in animals sensitized to the action of radiation by the administration of para-chloromercurybenzoate, the level of protein thiols (method of detection: Barrnett-Seligman histochemical reaction followed by photographic cytophotometry) in bone marrow cells and the postradiation survival are significantly reduced. It was concluded that thiols play a significant role in the determination of the radiosensitivity of the cell. (tr-auth)

27070 (AEC-tr-7507, pp 164-169) COMPARATIVE CHARACTERIZATION OF BONE MARROW HEMATOGENESIS OF DOGS AFTER ACUTE PROTON IRRADIATION UNDER CONDITIONS OF PARTIAL PROTECTION OF A PART OF THE BONE MARROW. Kalandarova, M. P. 1973. Translated from Radiobiologiya; 13: No. 5, 774-778(1973).

In Radiobiology.

The functional activity of the bone marrow under conditions of partial shielding (the residual doses under the shield were 35, 60, 70, and 120 rad) and its influence on hemopoiesis of the organism irradiated at a dose of 350 and 600 rad, were investigated. The functional activity of partially irradiated bone marrow proved higher at the lowest radiation dose under the shield. In the case of nonuniform irradiation influences at doses inducing a bone marrow nature of the damage to the organism, the outcome of radiation sickness depends to a substantial degree on the functional state of the partially irradiated bone marrow. (tr-auth)

27071 (AEC-tr-7507, pp 170-173) ROLE OF THE AMINO GROUP IN THE RADIOPROTECTIVE EFFECT OF SULFUR AND NITROGEN-CONTAINING COMPOUNDS. Kostyukovskii, Ya. L.; Vladimirov, V. G.; Slavachevskaya, N. M.; Strel'nikov, Yu. E. (Military-Medical Academy, Leningrad). 1973. Translated from Radiobiologiya; 13: No. 5, 778-781(1973).

In Radiobiology.

The radioprotective activity of certain sulfur-containing compounds, containing other groups in place of the amino group, was investigated. The presence of an amino group in the β-position to the sulfur-containing group is not necessary for the manifestation of the radioprotective effect by alkanethiols. (tr-auth)

27072 (AEC-tr-7507, pp 174-178) INFLUENCE OF SHIELDING OF PART OF THE BONE MARROW ON THE DIGESTIVE FUNCTIONS OF THE INTESTINAL EPITHELIUM OF IRRADIATED RATS. Kuzina, V. A.; Remizova, I. V. (Central Scientific Research Roentgenoradiological Inst., Leningrad). 1973. Translated from Radiobiologiya; 13: No. 5, 782-786(1973).

In Radiobiology.

The activity of certain intestinal enzymes (invertase, alkaline phosphatase, maltase) on the surface of the mucosa of the upper regions of the small intestine (and a homogenate of it) was investigated for rats totally irradiated at a dose of 600 R and irradiated with shielding of the hind limbs at various periods after irradiation (up to 30 days). Shielding of part of the bone marrow reduces the severity of the radiation changes in the enzymatic activity of the intestinal epithelium after irradiation and has a stimulating influence on the subsequent processes of restoration of the activity of hydrolytic enzymes. (tr-auth)

27073 (AEC-tr-7507, pp 179-181) DYNAMICS OF THE POSTRADIATION DEATH OF MICE AND RATS IRRADIATED AT VARIOUS PERIODS OF POSTNATAL DEVELOPMENT. Bogatyrev, A. V.; Timoshenko, S. I.; Sverdlov, A. G. (Inst. of Nuclear Physics, Leningrad). 1973. Translated from Radiobiologiya; 13: No. 5, 786-788(1973).

In Radiobiology.

Age peculiarities of the radiosensitivity and the nature of the death of mice irradiated with x rays were detected. Newborn mice are less resistant to the action of radiation. Newborn animals and animals at an age of one and two weeks died chiefly of damage to the hematogenic system; at the age of four weeks greater vulnerability of the gastrointestinal tract is observed. (tr-auth)

27074 (AEC-tr-7507, pp 182-186) CERTAIN ASPECTS OF THE POWER ACTIVITY OF THE HEART IN THE NORMAL STATE, DURING DINITROPHENOL POISONING, AND RADIATION SICKNESS. Daniyarov, S. B.; Schastlivyi, O. Ya. (Kirgiz State Medical Inst., Frunze, USSR). 1973. Translated from Radiobiologiya; 13: No. 5, 789-792(1973).

In Radiobiology.

The potentialities of the adaptive mechanisms of the cardiovascular system in irradiated animals (dogs, cold-blooded animals) were investigated. A pronounced limitation of these compensatory mechanisms after irradiation was demonstrated by the method of functional loads. A great similarity in the nature of the experimental data was detected for irradiated animals and in a series of experiments with 2,4-dinitrophenol (2,4-DNP) poisoning. Experiments with the joint action of irradiation and 2,4-DNP emphasized the importance of the disruption of processes of oxidative phosphorylation in the mechanism of the influence of ionizing radiation on the tissue structures. (tr-auth)

27075 GENETIC TESTS IN MICE OF CAFFEINE ALONE AND IN COMBINATION WITH MUTAGENS. Thayer, P. S.; Kensler, C. J. (Arthur D. Little, Inc., Cambridge, MA). Toxicol. Appl. Pharmacol.; 25: 157-168(Jun 1973).

The possible mutagenicity of caffeine was studied in mice by the dominant-lethal method, in three experiments. Male mice were given caffeine in drinking water for 8 weeks at 3.6, 13.4, 49, and 122 mg/kg/day (comparable to human consumption of 2.8 to 95 cups of coffee per day). Subsequent mating of each of six males from each group to five females per week for 8 weeks showed no significant increase in dominant-lethal mutations (embryonic deaths) whether expressed as early deaths per pregnant female or as mutation index. Although males consuming the two higher levels of caffeine produced fewer pregnancies, litter sizes of females giving birth were not reduced. Single ip injections of caffeine (15 mg/kg) were given to groups of male mice prior to, subsequent to, and immediately at the time of receiving x-rays (100 R). Each of five males from each group was mated to five females per week for 7 weeks. Embryonic deaths did not show any enhancing effect of caffeine on the mutagenicity produced by the irradiation. Three groups of male mice ingested caffeine in water for 16 weeks at levels of 0, 4, and 13 mg/kg/day. Subgroups of five from each group were given either: no further treatment, a single dose of triethylene melamine at 0.2 mg/kg, or 100 R of x ray, and mated for 7 weeks as above. Fertility and litter size were not affected by the caffeine pretreatment, nor did it modify the induction of dominant-lethal mutations by triethylene melamine or x rays. Litter sizes showed no significant preimplantation losses in any experiment. Thus, under the conditions described herein and at the doses employed (higher than human exposure), there was no evidence for the mutagenicity of caffeine or the inhibition of DNA repair mechanisms in these mammalian systems. (auth)

27076 EFFECTS OF WHOLE-BODY GAMMA IRRADIATION ON VARIOUS CHEMICAL PROPERTIES OF MUSCLE. Eisele, G. R. (UT-AEC Agricultural Research Lab., Oak Ridge, TN); Mraz, F. R.; Johnston, M. R. Contract AT(40-1)-GEN-242. J. Anim. Sci.; 38: No. 1, 20-23(1974).

Swine were exposed to a total air dose of 700 R at a rate of 1 R or 45 R/min of γ radiation. Chemical determinations of the teres major muscle were made 10 days postexposure and after a post-slaughter interval of 5 days. No differences in ether extract, moisture content, crude protein, or soluble protein were observed in the 1 R/min group. However, the pH of the muscle at slaughter in this group was higher than control muscle and decreased with storage. Muscle from the 45 R/min animals yielded more ether extract at slaughter and after the storage phase, while moisture content was lower at both times. A reduction in soluble protein was noted during the storage phase and higher pH values at slaughter. (auth)

27077 EFFECT OF RADIATION ON METABOLISM OF SELECTED MINERALS IN CATTLE. Sasser, L. B.; Wade, L. Jr.; Bell, M. C. (UT-AEC Agricultural Research Lab., Oak Ridge, TN). Contract AT(40-1)-GEN-242. J. Anim. Sci.; 38: No. 1, 178-185(1974).

Zinc, Cu, Ca, Mg, and Fe contents of plasma and/or erythrocytes of steers were studied following exposure of the steers to either whole-body γ irradiation, β irradiation of the gastrointestinal tract, β irradiation of the skin, or all combinations of the above. Gastrointestinal (GI) irradiation reduced plasma Zn concentrations 1, 2, and 3 weeks after irradiation, but no detectable change occurred in the erythrocyte concentration of stable Zn. The uptake of ^{65}Zn by erythrocytes from control steers averaged about 5%; whereas the uptakes of the GI- and skin-irradiated steers exceeded 10%. Hypoferremia and hypercupremia accompanied the injury and infection produced by GI and skin irradiation. The decline of plasma Ca and Mg levels following GI irradiation appeared to be the result of radiation-induced anorexia, as control animals with a restricted feed intake had a similar reduction in plasma Ca and Mg. (auth)

27078 EXPERIMENTAL MODEL FOR STUDY OF SUDDEN DEATH FROM VENTRICULAR FIBRILLATION OR ASYSTOLE. Lee, K. T.; Lee, W. M.; Han, J.; Jarmolych, J.; Bishop, M. B.; Goel, B. G. (Albany Medical Coll.). Amer. J. Cardiol.; 32: 62-73(Jul 1973).

Sudden death as a result of cardiac arrhythmias can be induced in swine by combining precordial x irradiation and an atherogenic diet. Hypothyroidism was not essential to the rapid induction of disease. The electrical activity of the heart was monitored during the terminal episode in 18 swine; 13 electrocardiograms showed ventricular fibrillation and 5 showed ventricular asystole. All 18 animals had advanced coronary atherosclerosis, and 14 had anatomically demonstrable myocardial infarcts. In a correlated separate experiment, ventricular fibrillation threshold was significantly lower in atherosclerotic swine. Infusion of lidocaine increased the fibrillation threshold 4-fold in these animals. This animal model appears to be useful for other investigations related to cardiac arrhythmias. (auth)

27079 EFFECTS OF ^{60}Co GAMMA IRRADIATION ON THE MATURATION OF RAINBOW TROUT. Tashiro, F. (Gifu Fisheries Experimental Station, Hagiwara, Japan). Nippon Suisan Gakkaishi; 38: No. 8, 793-797(Aug 1972). (In Japanese).

Eight groups of eyed eggs were subjected to gamma doses of 100, 200, 400, 500, 600, 800, 1000, and 2000 rads, respectively. All the groups were incubated after irradiation and the fry were reared until they reached a mature stage. There appeared no differences in the rate of hatching among the eight groups. However, all the fry that had received above 800 rads of the gamma irradiation died before reaching the advanced fry stage, whereas 50 to 80% of the fry that were subjected to less than 600 rads survived. A high percentage of deformed alevins was observed in the 2000 rads group. In the groups exposed to more than 400 rads of gamma rays, the percentage of fully mature fish decreased with the increase in gamma-ray dose. This phenomenon was observed more markedly in the females than in the males. In the groups that received less than 200 rads, the percentage of mature fish was similar to that of the unexposed control group. (auth)

27080 COMPARATIVE LONG-TERM EFFECTS OF LIVER DAMAGE IN THE RAT AFTER (a) LOCALIZED X IRRADIATION AND (b) LOCALIZED X IRRADIATION IN THE PRESENCE OF A STRONG HOMOGENEOUS MAGNETIC FIELD. Wordsworth, O. J. (Queensland Inst. of Tech., Brisbane, Australia). Radiat. Res.; 57: No. 3, 442-450(Mar 1974).

Rats were subjected to a fractionated x-ray dose of 6000 rads to the liver and a fractionated x-ray dose of 6000 rads to the liver carried out in the presence of a static 6000 Oe homogeneous magnetic field applied to the animals at right angles to the incoming x rays. Serum concentrations of alanine aminotransferase (AlT), aspartate aminotransferase (AsT) and total hemolytic complement were determined at various times up to 153 days after commencement of treatment. All three serum components exhibited marked effects, which indicated that the magnetic field applied during x-irradiation enhanced liver damage. The magnetic field applied alone also caused variations in serum levels of the three components studied. (auth)

27081 RAPID RADIATION CELL DEATH AND CELL PROLIFERATION IN INTESTINAL EPITHELIUM AFTER 1000-RAD IRRADIATION. Tsubouchi, S.; Matsuzawa, T. (Aichi Cancer Center Research Inst., Nagoya, Japan). Radiat. Res.; 57: No. 3, 451-458(Mar 1974).

Rapid cell death of mouse intestinal crypt cells was investigated after 1000 rads of x-irradiation by counting pyknotic cells in tissue sections. The number of normal crypt cells decreased with the appearance of pyknotic cells after irradiation. Pyknotic cells appeared within 30 min and the number of pyknotic cells reached a maximum 4 hr after irradiation. From the disappearance rate of the cells the mean life span of pyknotic cells was estimated to be 2 hr or less. Pyknotic cells observed within 4 hr after irradiation were produced without cell division, and this interphase death by pyknosis occurred in all phases of cell cycle. The tendency for the cells to develop into pyknotic cells was high in G2 phase, intermediate in S phase, low in G1 phase. The increase in mitotic index and the decrease in pyknotic cells from the second to the fifth day after irradiation were inversely related. After the disappearance of pyknotic cells, rapid recovery of the cell population took place with logarithmic cell proliferation and shortening of the cell cycle. Recovery to the normal cell population level was attained within 5 days after irradiation. (auth)

27082 APPROACH TO STATISTICAL FACTORS IN RADIATION DAMAGE THROUGH THE ANALYSIS OF THE 3.5-DAY EFFECT OF WHOLE-BODY X-RAYED CHICK EMBRYOS. von Doehren, R. (Univ., Mainz). Radiat. Res.; 57: No. 3, 465-470(Mar 1974).

Microdosimetry and the consideration of stochastic processes on the cellular level (biological stochastics) were applied to the analysis of the 3.5-day effect of x rays on chick embryos. Vital processes are subject to such stochastic factors. The experimental results are in good agreement with sensitive volumes about 2 μm in diameter. This approximates the volumes of cell nuclei. The theoretically deduced lower limit of the diameter of the sensitive volumes increases toward the diameter of the whole cell, when certain environmental parameters are changed during the incubation after the irradiation. (auth)

27083 MAMMARY TUMORIGENESIS THROUGH IRRADIATION OF MICE. Warren, S.; Gates, O. (New England Deaconess Hospital, Boston). Radiat. Res.; 57: No. 3, 488-507(Mar 1974).

RAP mice, possibly harboring mammary tumor virus (MTV), of representative ages were exposed to limited or lifetime whole-body continuous gamma and to fractionated x-irradiation. Doses varied from 30 to 2100 R and dose rates from 0.062 to 121 R/day in the two series GA and PN in which mammary cancer incidence was elevated. Induction of mammary cancer was found to be related to the dose range for ovarian tumorigenesis, 30 to 500 R, but unrelated to age when exposed. There was no statistically significant correlation between mammary cancer and ovarian tumors. Active MTV infection was suggested by cancer-prone litters in one irradiated (PN U + SR) and one unirradiated series (OCB). Unirradiated descendents of perinatally irradiated mice with an inherited hormonal disorder had a lower incidence of mammary cancer than stock virgin mice. The balance of evidence pointed to induction of mammary cancer through systemic change set in motion by irradiation. (auth)

27084 IMMUNOLOGICAL MEMORY IN MICE FOLLOWING LETHAL IRRADIATION AND SHIELDING OF AN EXTREMITY. Khaitov, R. M.; Panteleev, E. I. Zh. Mikrobiol., Epidemiol. Immunobiol.; No. 6, 19-23(1973). (In Russian).

CBA mice, 4 to 5 months old and 24 to 26 g in weight, were employed in studies to determine the effects of lethal irradiation (800 R) on the secondary immune response and the radioresistance of memory cells. Different groups of animals were either only immunized (0.5 ml of 2% SRBC, intraperitoneally) (controls), or immunized and 1.5 months later irradiated with protection of the right posterior extremity by a metal shield (6 mm lead, 1 mm aluminum) and reimmunized 12 days later, or immunized and irradiated with shielding without reimmunization, or irradiated with shielding and then immunized. The last group consisted of animals that were immunized, subjected to total body irradiation, and then were reimmunized. Comparison of blood hemagglutinin titers for the different groups at a comparative period of time, corresponding to 14 to 24 days after the secondary immunization, revealed that only the group that had been immunized, irradiated with shielding, and reimmunized gave an anamnestic response with a titer (in $\log_2$) of 8.7 ± 0.25 ($M \pm SE$). The titers for the other irradiated groups ranged from 4.2 to 4.6; the corresponding titer for the non-reimmunized

controls was 5.9 ± 0.14. Thus, shielding of bone marrow was required for an anamnestic response in irradiated mice; irradiation alone caused the titers to fall. Further studies with spleen cell transfer experiments showed that cells from immunized and totally irradiated animals would not endow unimmunized totally irradiated recipients with the capacity to respond with an anamnestic reaction. However, spleen cells from immunized unirradiated donors did endow these recipients with the ability to respond with a secondary immune response demonstrating that the immune memory cells are not radioresistan (JPRS)

27085 TUMOR IMMUNITY TO MURINE PLASMA CELL TUMORS. II. Essential Role of T Lymphocytes in Immune Response. Rouse, B. T.; Roellinghoff, M.; Warner, N. L. (Inst. of Medical Research, Melbourne). Eur. J. Immunol.; 3: 218-224(Apr 1973).

Spleen cells, thoracic duct lymphocytes and adherent peritoneal exudate cells from mice immunized to syngeneic plasma cell tumors were capable of transferring specific protective immunity to these tumors. Pretreatment of these cells with anti-Θ serum on anti-lymphocyte serum, but not with anti-k serum, effectively abolished the ability of lymphoid cells to transfer this immune response. These studies demonstrate that T cells are essential in the adoptive transfer of immunity. Furthermore, immunization of athymic (nude) mice to plasma cell tumors was not achieved. Attempts to activate normal macrophages in vitro with sensitized lymphoid cells were unsuccessful. Admixture of immune lymphoid cells and target tumor cells to unrelated tumor cells did not inhibit the growth of the unrelated tumor cells. It is proposed that the immune response to syngeneic tumor associated antigens of plasma cell tumors not only involves essential sensitization of T lymphocytes, but that activated cytotoxic T lymphocytes are directly responsible for inhibiting target tumor growth. (auth)

27086 CHANGES IN EHRLICH ASCITES CARCINOMA AFTER DEATH OF HOST MICE. Changes of Radiosensitivity of Tumor Cells. Miura, T. (Kobe Univ. School of Medicine, Japan). Nippon Gan Chiryo Gakkai-Shi; 7: 104-115(20 Jun 1972).

A series of experimental studies were carried out using Ehrlich ascites carcinoma. The radiosensitivity of those cells under such conditions were also studied. These results throw light on the problem of how the radiosensitivity of tumor cells is affected by the changes of the surrounding condition. Following death of the host, tumor cells are placed under anerobic conditions, but glycolysis is also inhibited. In the synthetic processes of nucleic acid, DNA synthesis was markedly inhibited shortly after death of the host, whereas RNA synthesis was maintained for a considerably prolonged period of time. In other words, it was suggested that the cessation of proliferation occurs within a short period of time, but the cellular function is maintained for a certain period of time. Furthermore, DNA synthesis which appeared to have been suspended after the death revived following the transplantation of cells to living mice. Within 6 hours of death, the uptake of trypan blue in tumor cells increased and at the same time DNase activity became remarkable. Six hours after the death of the host, the transplantability of tumor cells changed also. The oxygen tension in ascites in the group of dead mice showed significant decrease as compared with the control group (living mice), together with a significant decline in the body temperature. The PH of ascites of dead mice was lower than that of the control. The ascites was drawn from the dead mice irradiated in a dosage of 500 R and 1000 R 1, 2, and 3 hours after death, and from the irradiated living mice (control). These two kinds of ascites were transplanted intraperitoneally in one group (ascites form) and subcutaneously in another group (solid form) respectively. The survival of animals of the group transplanted with ascites from the dead mice was shortened as compared with the control. The weight of the solid tumor deriving from dead mice was also heavier than that of the control. From these experimental results, it may be possible to conclude that the irradiation on Ehrlich ascites carcinoma is less effective in the dead than in the living host. (auth)

27087 EFFECTS OF RADIATION ON THE AMINO ACID METABOLISM OF THE SUPRARENAL GLAND. Kovacs, V.; Kadar, L. (Babes-Bolyai Univ., Cluj). Kiserl. Orvostud.; 25: No. 4, 421-425(Aug 1973).

White rats were administered 0.5 μ Ci/g body weight of ^{35}S-labeled methionine in conjunction with a standard diet. Control animals were given ^{75}Se-labeled selenomethionine; all were subsequently irradiated with 200 R and 500 R x-rays. Radioactive sulfur and selenium in the suprarenal gland were determined radiometrically, using radiochromatographic techniques. The analyses were carried out in the protein fractions also. Twenty-four hours following the irradiation more ^{75}Se-labeled material became incorporated both in the gland and the protein fractions than ^{35}S-labeled material. There was also evidence of a shift in the S-amino acid concentrations of the various protein fractions caused by the irradiation. No definitive conclusions about damage to DNA radiation damage could be made on the basis of the data obtained in these experiments. Eight references, including 5 Romanian, 1 Russian, and 2 Western. (JPRS)

27088 EFFECT OF IONIZING RADIATION ON THE BONE GROWTH OF THE PROXIMAL PART OF PELVIC LIMB. Horak, J. (Univ. P. J. Safarika, Kosice, Czech.); Horakova, A.; Chlebovsky, O. Folia Vet.; 15: No. 3-4, 83-92(1971). (In Slovak).

The effect of x radiation was studied on the growth of os ilium, the femur, the tibia, and the fibula in the fetus of rats. Pregnant female rats were exposed to a dose of 250 R, this either of single irradiation on the 11th, 12th, 13th, 14th, and 15th days following fertilization or of chronic irradiation applied over the 1st to the 19th day of pregnancy. The fetuses were removed on the 19th day of pregnancy. The exposure was ascertained to inhibit or to stimulate the growth in dependence on the degree of the development of the fetus at a time of exposure. It was verified that during development, the bones manifested stages of increased radiosensitivity as well as of relative radioresistance. The most marked changes were observed in the fibula. (auth)

27089 PNEUMOCONIOSOGENIC PROPERTIES OF DIFFERENT DUST SAMPLES FROM SUPERPHOSPHATE PRODUCTION. Khamitova, V. Z.; Knysh, V. S. Tr. Nauch.-Issled. Inst. Kraev. Patol., Alma-Ata; No. 23, 93-95(1972). (In Russian).

For 12 months, rats were administered intratracheally 50 mg of simple superphosphate dust suspension containing 25% U_2O_5, 40% CaO, 2% Al_2O_3 and Fe_2O_3, 2% F and 5 to 19% SiO_2 (first group), granulated superphosphate of almost the same composition (second group) and ammophos containing an admixture of NH_3 (third group). In the animals in the first group after one to three months marginal pulmonary emphysema, desquamation and tearing away of the bronchial epithelium, constriction and sometimes obliteration of the vessels, and so on were detected. After 6 to 12 months, exudate appeared in the lumen of the bronchi and alveoli, connective tissue nodes and indurations developed in the pulmonary parenchyma comprising lymphoid cells and collagenic fibers. In the animals of the second group, analogous, but more sharply expressed symptoms of the development of nodular-diffuse pneumoconiosis were noted. This process developed still more intensely in the animals of the third group. It is considered that the primary toxic effect is caused by the P_2O_5, F, and NH_3. (JPRS)

27090 AMINO-ETHYL-ISOTHIOURONIUM BROMIDE HBr (AET) AS A RADIOPROTECTIVE SUBSTANCE FOR THE LENS. Ismail, S.; Dienstbier, Z.; Soliman, A. M.; Hosny, F. (National Research Centre, Cairo). Bull. Ophthalmol. Soc. Egypt; 64: 389-394(1971).

The possibility of using AET for protecting the lens from the effects of ionizing radiation was studied. Phosphorous-32 uptake by the lens was used to determine the protective effect of AET. Guinea pigs were injected with AET 15 min. before irradiation with 400 or 1000 R of x rays. The results showed that regardless of the dose, ^{32}P uptake was lower in the lens of AET-treated animals than in those receiving only irradiation. (ERB)

27091 MODIFICATION OF THE ACUTE TOXICITY OF MUTAGENIC AND CARCINOGENIC CHEMICALS IN THE MOUSE BY PREFEEDING WITH ANTIOXIDANTS. Cumming, R. B.; Walton, M. F. (Oak Ridge National Lab., TN). Food Cosmet. Toxicol.; 11: 547-553(1973).

Butylated hydroxytoluene (BHT) fed to male mice for 4 wk gave significant protection against mortality caused by ethyl methanesulphonate (EMS), n-propyl or isopropyl methanesulphonate, ethylene dibromide, diethylnitrosamine and cyclophosphamide. It did not protect male mice against x rays, methyl methanesulphonate (MMS), N-methyl-N'-nitro-N-nitrosoguanidine or dipropylnitrosamine, but female mice were protected from the lethal effects of MMS. Other agents, such as butylated hydroxyanisole, 1,2-dihydro-6-ethoxy-2,2,4-trimethyl quinoline and sodium phenobarbitone also gave protection against EMS toxicity. The protection, when it occurred, may have been due to the induction of drug-metabolizing enzymes. (auth)

27092 EFFECT OF HIGH DOSES OF X RAYS ON THE NEUROSECRETION OF CATS HYPOTHALAMUS. Kopaczyk, F.; Kowalski, E.; Pawlaczyk, J. (Medical Academy, Poznan, Poland). Med. Pracy; 139-148(1972). (In Polish).

The effect of high doses of x rays on the hypothalamo-hypophyseal system was studied on 15 adult cats, both males and females. It was observed that ionizing radiation induced the secretory activity of neurons and accelerated the passing of

neurosecreta from cells to axons and from the posterior lobe of the pituitary body to the vascular system. (auth)

27093 EFFECT OF X RAYS ON THE NEUROSECRETORY SYSTEM OF WHITE MICE. Czechowicz, K. (Medical Academy, Wroclaw). Zool. Pol.; 22: 135-149(1973).

Changes in the neurosecretory nuclei of the hypothalamus following the x irradiation of white mice are reported. From the results it can be inferred that neurosecretory cells destroyed by irradiation are replaced by cells from the neurohypophysis, and that the changes caused in response to the x ray dose used are reversible. (auth)

27094 STUDIES ON LEUKOSOGENIC ACTIVITY OF X RAYS IN MICE, WHOSE PARENTS RECEIVED BOVINE LEUKOTIC MATERIAL IN FEED. Grundboeck, M.; Wilczynska-Ciemiega, K. (Veterinary Research Inst., Pulawy, Poland). Bull. Vet. Inst. Pulawy; 16: No. 1-2, 27-34(1972).

Mice deriving from parents fed with bovine leukotic material did not show any leukotic symptoms in spite of irradiation with x rays. Statistically significant differences in the level of large and small lymphocytes were found between the experimental and control groups of animals. The average size of the thymus was smaller in control animals, however, in this group three cases of leukotic tumor localized in the thymus were observed. Lymphocytic infiltrations occurred in kidneys of all males of experimental group, while they were found only in one case in controls. Appearance of analogical infiltrations in females did not reveal any differences between the two groups of animals. (auth)

27095 NUCLEAR DAMAGES AND REPAIR IN IRRADIATED RAT LIVER. Betz, E. H.; Barbason, H. (Univ., Liege). pp 149-153 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From first European biophysics congress; Baden, Austria (14 Sep 1971).

The following changes were investigated in the liver of rats exposed to a whole-body irradiation of 450 R and hepatectomized 1 hr to 15 weeks later: mitotic lag, variations of mitotic index, occurrence of micronuclei and anatelophasic bridges. The mitotic lag and a significant amount of the damage leading to the formation of micronuclei have already disappeared after a post-irradiation delay of 48 hrs. The recovery of the mitotic activity takes more time and 6 weeks are needed in order to get a first mitotic wave similar to that of unirradiated controls. During the same period of 6 weeks, the frequency of anatelophasic bridges increases and then drops. These results could be explained by a difference in the recovery rate of various damages. The damage responsible for the formation of micronuclei seems to be largely repaired before the complete recovery of the mitotic activity. On the contrary, the damage leading to bridging takes more time to be partly repaired. (INIS)

27096 EFFECTS OF X RAYS AND IMURAN ON ANTIBODY AND INTERFERON FORMATION. Sorokin, A. M. (Inst. of Epidemiology and Microbiology, Moscow). Vop. Virusol.; No. 4, 443-446(1973). (In Russian).

Studies were made of the effects of imuran and x rays on antibody and interferon production in 18 to 20 g mice and 2.5 to 3 kg rabbits against intravenously injected Newcastle disease virus. In mice, x rays at a dose of 60 R had no effect on antibody or interferon levels, but 500 R cut the serum interferon levels in half and completely abolished the hemagglutinin response; 1000 R decreased the serum interferon levels 6 to 18 fold. In rabbits x rays at a dose of 1000 R completely abolished the antibody response and decreased the serum interferon response 32 fold. Additional studies with mice showed that x rays had no effect on interferon production by peritoneal macrophages, but depressed leukocyte interferon formation from 128 units/ml to 4 units/ml at doses ranging from 60 to 1000 R. Administration of up to 750 mg of imuran per kg of body weight to mice had no effect on antibody or interferon formation. However, when 500 to 2500 mg were given over a period of 8 days (5 to 25 mg/day), 4 to 8 fold depression of antibody was noted with 500 mg, but interferon response remained unaffected. At 1250 mg, antibody titer was completely abolished, and serum interferon was depressed four to sixteen fold. The studies showed that antibody formation was more susceptible to x rays and imuran than interferon production and that different cells were involved. Furthermore, the results also showed that under these conditions the primary source of interferon consisted of macrophages and small radiosensitive lymphocytes. (JPRS)

27097 EXTRACORPOREAL IRRADIATION OF BLOOD. An Experimental Investigation on Animals. Kriek, H. R. Amsterdam; Vrije Universiteit (1973). 104p. (In Dutch).

Thesis.

The blood of the mongrel dog was circulated through an external loop and irradiated with ionizing radiation from an x ray source. Lymphocyte depletion occurred after an absorbed dose of 700 rad given in two periods of eight hours each. (auth)

27098 GENERAL AND LOCAL HEMODYNAMIC CHANGES IN ANESTHETIZED RATS INDUCED BY SEROTONIN GIVEN INTRAPERITONEALLY IN A RADIOPROTECTIVE DOSE. Kuna, P. (Purknye Medical Research Inst., Hradec Kralove, Czech). Radiobiol.-Radiother.; 14: No. 6, 717-726(1973).

Cardiac output, stroke volume, blood volume, hematocrit, mean arterial pressure, heart rate, total peripheral vascular resistance, cardiac output distribution and organs' blood flow changes after the intraperitoneal radioprotective dose of serotonin in anesthetized rats were determined. (auth)

27099 BRAIN BLOOD FLOW RATES FOLLOWING ADMINISTRATION OF CYSTAMINE, AET, SEROTONIN, AND 5-METHOXYTRYPTAMINE. Kuna, P. (Purknye Medical Research Inst., Hradec Kralove, Czech). Radiobiol.-Radiother.; 14: No. 6, 757-759(1973).

The importance of central regulation in hemodynamic responses to radioprotectors and the changes of CNS activity following introduction of radioprotective agents were reasons for determining the brain blood flow at the time of their radioprotective efficiency in rats. (auth)

27100 INFLUENCE OF ADRENALINE ON THE CHANGE OF COAGULABILITY OF RABBIT BLOOD IN ACUTE RADIATION SICKNESS. Andrusko, I. A.; Ratmanova, V. I. Radiobiol.-Radiother.; 14: No. 6, 689-693(1973). (In German).

In experiments with rabbits, the influence of adrenaline on blood coagulability was studied. A radiation injury of the coagulating system of blood was found not to be caused by a disturbance of the contact phase of hemocoagulation. During marked hemorrhagic manifestations, the hypercoagulemia reaction to the introduction of adrenaline is maintained which does not differ from the normal reaction as to the extent of its distinctness. (auth)

27101 ANIMAL-EXPERIMENT DATA ON THE PROGNOSTIC ROLE OF THE SEQUENCE OF COMBINED RADIATION AND THERMAL TRAUMA. Novak, J.; Nagy, J.; Bardos, E.; Warndorfer, I. Kiserl. Orvostud.; 25: No. 4, 406-410(Aug 1973). (In Hungarian).

Thermal (boiling water) and radiation (x-ray) traumas were inflicted to the depilated chest area of albino rats to investigate the effects of trauma sequence and interval on mortality. In the experiments, the time elapsed between the two traumas was 15 min on the average. In cases where the radiation trauma preceded the thermal trauma, mortality increased in a statistically significant manner over those where the sequence was reversed. It was theorized that the thermal trauma represents a greater primary shock than the radiation trauma under identical biological orders of magnitude. It has already been reported that such a sequence effect applies if the interval between the two traumas is relatively long (one hour or more). The present experiments showed that this effect applies also if the interval is relatively short (approximately 15 minutes). (JPRS)

27102 COMPARATIVE RADIOSENSITIVITY OF NUCLEAR AND MITOCHONDRIAL DNA SYNTHESIS AND REGENERATING RAT LIVER. Goutier, R.; Baugnet-Mathieu, L.; Baes, C. (CEN, Mol, Belgium). pp 161-162 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From 1st European biophysics congress; Baden, Austria (14 Sep 1971).

Male rats were subjected to whole-body x-ray-irradiation and killed from 2 to 30 hours after irradiation. ^{14}C-thymidine was injected intravenously before sacrifice in order to study differences in the synthesis of nuclear and mitochondrial DNA. Mitochondrial DNA is independent of the mitotic cycle also in irradiated organs, inhibition occurring only through that of enzymatic processes, and less than in nuclear DNA-synthesis, which is inhibited by a temporary block of the mitotic cycle. (INIS)

27103 ONTOGENY OF THE MURINE IMMUNE SYSTEM: DEVELOPMENT OF ANTIGEN RECOGNITION AND IMMUNE RESPONSIVENESS. Yung, L. L. L.; Wyn-Evans, T. C.; Diener, E. (Univ. of Alberta, Edmonton). Eur. J. Immunol.; 3: 224-228(Apr 1973).

The grafting of a single spleen colony obtained from irradiated mice protected with 12-day fetal liver will reconstitute the lymphopoietic and erythropoietic system of irradiation-deprived syngeneic recipients. Using this experimental model, the early events during the ontogenic development of the immune system were studied in CBA mice. Cells capable of binding radioiodine labeled Salmonella adelaide polymerized flagellin were first detectable

after 18 to 20 days of lymphopoiesis starting from presumably a single stem cell. However, antibody-forming cell production after immunization against the same antigen was not demonstrable until days 19 to 26. The same sequential development of antigen recognition (by rosette formation) followed by immune reactivity was observed for sheep red cell antigens, both events occurring later than those for POL. Our observed requirement for the ontogeny of an antigen-recognition spectrum is compatible with Jerne's theory on the generation of antibody diversity. (auth)

27104 EFFECTS OF X IRRADIATION ON CELL PROLIFERATION AND DNA SYNTHESIS INDUCED BY ADMINISTRATION OF ISOPROTERENOL IN SALIVARY GLANDS OF THE MOUSE. Furuno, I.; Iwasaki, T.; Matsudaira, H. (National Inst. of Radiological Sciences, Anagawa, Japan). Radiat. Res.; 57: No. 3, 431-441(Mar 1974).

Changes in proliferative response to three successive administrations 48 hr apart of isoproterenol were studied in the parotid gland of the mouse previously given local x-irradiation. X-irradiation produced dose-dependent inhibition of DNA synthesis and cell proliferation induced by the drug. A D_0 of approximately 900 R was obtained from the dose-response curve constructed on the basis of changes in the DNA content of the organ at the end of the mitotic stimulations. Similarly, split-dose experiments showed a slight but significant recovery from the radiation damage within a few hours after irradiation. However, complete recovery in the capability of undergoing DNA synthesis and cell proliferation on isoproterenol stimulation took much longer. (auth)

27105 DIURNAL VARIATION IN REPRODUCTIVE CAPACITY OF MALE MICE AFTER FRACTIONATED IRRADIATION OF SPERMATOGONIA. Oftedal, P.; Mecsei, R. (Norsk Hydros Institutt for Kreftforskning, Oslo). pp 173-177 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From first European biophysics congress; Baden, Austria (14 Sep 1971).

Experiments in fractionated irradiation of mice spermatogonia with irradiation periods separated by intervals of various lengths, indicated that the radiosensitivity of the mice reproductive capacity has a diurnal rhythm. To test this hypothesis, irradiations with 18, 21, 24, 27 and 30 hours intervals were performed at various hours of the day. Significant differences were obtained between the responses to irradiations performed at 11h and at 17h. The variation in response appears to be tied to the conditioning-challenging dose situation. (INIS)

27106 LATE EFFECTS OF GAMMA-IRRADIATION OF NEWBORN MICE. III. Chromosomal Aberration in Bone Marrow. Slowikowska, M. G.; Gajewski, A. K.; Grzymala, W. J. (Zaklad Ochrony Radiologicznej i Radiobiologii Panstwowego Zakladu Higieny, Warsaw). Nukleonika; 18: No. 12, 625-632(1973). (In Polish).

Chromosomal aberrations in bone marrow of mice of both sexes irradiated with four doses of gamma rays: 0 R (control), 150 R, 300 R, and 450 R were studied four hundred days later. The yield of chromosomal breaks per metaphase and the percent of aneuploid cells increased with the dose of radiation. The number of polyploid cells was also significantly increased but the mean value of mitotic index in irradiated groups was significantly decreased. (auth)

27107 COMBINATIONS OF THE EFFECT OF RADIOTHERAPY, CHEMOTHERAPY, AND PHA ON TRANSPLANTED TUMORS IN MICE. Abstract. Mekori, T.; Robinson, E. (Rambam Government Hospital, Haifa, Israel). (1973). vp.

From 2nd meeting of the European Association for Cancer Research; Heidelberg, Germany (2 Oct 1973).

Six different drugs were used for chemotherapy: thiotepa, cyclophosphamide, methotrexate, vinblastine, vincristine, and actinomycin. No significant difference was observed between results for mice treated with a single form of therapy and non-treated controls. The combination of radiotherapy with chemotherapy was most effective. (GE)

27108 SUBBIOLOGICAL ASPECTS OF AGEING AND THE CONCEPT OF BIOLOGICAL CATHODE PROTECTION. Molnar, K. (Semmelweis Medical Univ., Budapest). Mech. Ageing Develop.; 1: 319-326(Mar 1973).

A series of tentative experiments was carried out to investigate some aspects of the analogy between biological and non-biological ageing. Prolonged microdoses of H_2O_2 (as a purely oxidizing compound) decreased the lifespan and body weight of mice. So did positive electric charging, while continuous negative charging produced a comparatively longer life span and higher body weight on average. It also gave relative protection against the effects of whole-body exposure to x radiation at doses of 250 or 300 R administered at 90, 120, or 190 days of age. Positive electric charging is supposed to act as an electrochemical oxidant, while negative charge may protect biomolecules against spontaneous oxidative damage, as technological cathode protection counteracts the corrosion of metals. (CH)

27109 HEMATOPOIETIC FUNCTION OF THE LIVER AFTER WHOLE-BODY IRRADIATION OF NEW BORN MICE. Fischer, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin). pp 163-166 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971). (In German).

From 1st European biophysics congress; Baden, Austria (14 Sep 1971).

The dynamics of radiation induced injury and repair of the hemopoiesis in the liver of newborn whole-body irradiated mice were studied. Hemopoiesis was seen till the 15th day after irradiation. The relation between hemopoiesis in the liver and the radioresistance of newborn mice is discussed. (auth)

27110 METABOLIC ACTIVITY AND RADIO-REACTION OF ISOLATED PERFUSED RAT LIVER. Koenig, K.; Staehler, F.; Ungemach, R. (Univ., Hamburg). Strahlentherapie; 146: No. 4, 478-489(Oct 1973). (In German).

By deproteinization of the blood plasma of rats by means of an exchange transfusion, the protein metabolism of the liver was stimulated. With the technique of isolated organ perfusion the reaction of the liver was tested without the influences of the total organism. By varying the time intervals between deproteinization and the 3-hr perfusion, by incorporation studies with tritium-leucine, the maximum stimulation for albumin was found between the 6th and the 12th hr, for the globulinary protein in the 24th hr after deproteinization. The highest net protein synthesis was found 24 hrs after deproteinization. The influence of an irradiation with 500 to 5,000 rads of x rays was examined during a 3-hr perfusion, 24 hrs following deproteinization and irradiation. After irradiation with 500 rads, the induction of the additional synthesis of plasma proteins was nearly completely suppressed. Summarizing the results of these irradiation tests, it is shown that the cellular activity discloses the damages caused by irradiation and intensifies the degree of the radio-reaction. (auth)

27111 EARLY MORTALITY IN THE YOUNG CHICKEN AFTER EXPOSURE TO FAST NEUTRONS OR GAMMA RAYS. Montour, J. L.; Wilson, J. D. (Virginia Commonwealth Univ., Richmond). Radiat. Res.; 57: No. 3, 459-464(Mar 1974).

Two-day-old White Leghorn cockerels were exposed to various doses of ^{60}Co gamma radiation or high energy (14.5 MeV mean energy) neutrons from the Naval Research Laboratory, Isochronous Cyclotron in Washington DC. Early deaths (within 30 hr of exposure) were observed after exposure to both types of radiation. Chicks exposed to neutrons died in two distinct and separate time periods. These two modes of death were not apparent after the gamma irradiations. After either neutron or gamma exposure, survival time decreased as mortality level increased, reaching a minimum of approximately 5 hr. The 30-hr LD_{50} values were 519 ± 5.6 rads of neutrons and 939 ± 8.0 rads of gamma radiation; the relative biological effectiveness (RBE) at this mortality level was 1.81. (auth)

27112 COMPARISON OF HEMATOLOGICAL EFFECTS OF COBALT GAMMA RAYS AND GAMMA-NEUTRON CRITICALITY FLASHES. Malarbet, J. L.; Le Go, R.; Prudhomme, J.; Genest, L. (CEN, Fontenay-aux-Roses, France). (1973). vp. (In French).

From symposium on the effects of neutron irradiation upon cell function; Neuherberg, Germany (22 Oct 1973).

The criticality reaction was produced in a cylindric vessel by introduction of a solution of enriched uranium nitrate. During the 7 criticality experiments the energy spectra remained the same. The doses to the animals varied between 168 rads γ + 165 rads neutrons and 656 rads γ + 471 rads neutrons. The animals used for the experiment were male rats of the Carworth strain aged 3 month and weighing 350 g. The animals were irradiated individually. The ^{60}Co gamma dose was determined by the iron sulfate method. For the determination of the gamma-neutron dose, a more complex technique was necessary which is described in detail. Blood samples were withdrawn from the caudal vein 4.6 or 8 hrs post-irradiation. The number of erythrocytes and leukocytes was counted automatically by the Coulter Counter. The development after irradiation shows the same picture for both types of radiation and reflects the medullary aplasia. The polynucleated neutrophils undergo a rapid increase while the lymphocytes show a considerable decrease during the first hours after irradiation. The erythrocyte count increased during the first 2 d after irradiation, while the reticulocytes disappeared from the blood after 2 d. The results show clearly the

considerable disturbances of the hematopoiesis caused by the irradiation. The analysis of the different factors is a useful way to observe the course and to determine the RBE. The investigation of the recovery seems to be a new way to study the medullary dynamics. (GE)

Invertebrates

Refer also to abstracts 26993 and 27000.

27113 (AEC-tr-7507, pp 37-43) SIGNIFICANCE OF THE TOXIC EFFECT OF AN IRRADIATED MEDIUM IN THE POST-RADIATION DEATH OF CELLS. Communication 2. Experiments on Paramecium Caudatum. Bychkovskaya, I. B.; Ochinskaya, G. K. (Central Scientific Research Roentgenoradiological Inst., Leningrad). 1973. Translated from Radiobiologiya; 13: No. 5, 680-685(1973).

In Radiobiology.

In work conducted on paramecia by the method of individual culturing, it was shown that direct irradiation of cells with x rays and influence of an irradiated culture medium after irradiation at doses of 0.5 to 40 kR produce the same effect, a stable offspring mortality. The injurious action of an irradiated medium on infusoria was previously detected only after irradiation at enormous doses (of the order of hundreds of kR), when there was another form of cell lesion, death without division in the early periods after the influence. The results obtained in experiments on infusoria are similar to those on amoebae. (tr-auth)

27114 INABILITY OF POPULATIONS OF CALLOSOBRUCHUS MACULATUS TO DEVELOP TOLERANCE TO EXPOSURES OF ACUTE GAMMA IRRADIATION. Brower, J. H. (Dept. of Agriculture, Savannah). Ann. Entomol. Soc. Amer.; 67: No. 2, 287-291(Mar 1974).

The reproductive capacity and resistance to an acute dose of γ irradiation were determined for populations of Callosobruchus maculatus treated with substerilizing doses of irradiation each generation for 30 generations. Reproductive capacity was decreased by an ancestral history of irradiation, the reduction being positively correlated with both the size of dose per generation and the number of ancestral generations treated. Irradiation of the selected populations with an acute dose revealed no increase in tolerance, even after 30 generations. In general, the greater the amount of accumulated ancestral exposure to irradiation, the greater the sensitivity to further irradiation. The ability to develop a tolerance to ionizing irradiation may not be a general phenomenon in insects. (auth)

27115 RADIATION EFFECTS ON SILKWORM, BOMBYX MORI L., WITH SPECIAL REFERENCE TO THE CHANGES IN THE FREQUENCIES OF INDUCED SOMATIC MUTATIONS DURING DIFFERENT STAGES OF LARVAL DEVELOPMENT. Nakajima, M. (Tokyo Univ. of Agriculture and Tech., Fuchu, Japan); Takimoto, T.; Miyakoda, T. Nippon Saikingaku Zasshi; 41: No. 5, 359-364(Oct 1972). (In Japanese).

A few experiments were made to investigate the variations in radiosensitivity to induction of somatic mutations, during different stages from advanced embryonic stage to the third or fourth instar, by the use of normal skin and heterozygous striped individuals segregated from the crossing of (Nichi 124 × P^3) × daizo. Both kinds of individuals were irradiated at intervals with a dose of 1000 R for 20 min in acute or 72 hrs in chronic irradiations. Acute exposure at intervals to a single dose of γ rays showed a single peak of the frequencies of translucent spots induced in normal skin at the 20% stage of each instar. These peaks were gradually reduced in height with the progress of larval instar. In the case of the frequencies of white spot induced in heterozygous striped, a single peak was shown at the 50 to 80% stages of both the first and second instars. Whereas, in the third and fourth instars a single peak was observed at each 20% stage. These peaks also were reduced in height with the progress of larval instar. From these results, it was postulated that the stages for these peaks to appear were closely related to whether or not the dominant character for each one of the spots induced appears during the instar in question. In order to clarify the relation between dose irradiated and frequency for white spot to be induced, the second molting heterozygous striped larvae were irradiated with various kinds of doses at the dose rate of 155 R/min. The frequencies of white spots were in direct proportion to exponent of 1.745 of doses irradiated less than 1500 R, showing two hit event concerning white spot induction. The ratios of acute irradiation to chronic with respect to the frequencies for aberrant spots to be induced took a minimum value at the hatching stage, then increased gradually with the progress of larval growth. From the facts described above, we discussed the factors that would permit the decrease in radiosensitivity with the progress of larval development. (auth)

27116 EFFECT OF GAMMA IRRADIATION ON THE PROTEIN METABOLISM IN DROSOPHILIDAE. Vaidya, V. G.; Kothari, R. M.; Godbole, N. N.; Patil, S. F. (Univ. of Poona). Radiat. Res.; 57: No. 3, 545-550(Mar 1974).

Effect of gamma irradiation on protein metabolism was studied in four species of Drosophilidae. The following developmental stages of each species were irradiated at 27°C at a dose rate of 15 rads per second over a period of 2 min: egg, third-instar larva, three pupal stages, freshly emerged imago. In most cases irradiation caused considerable degradation of protein. Developmental stages showing maximal and minimal radiosensitivity differ in the species observed. Thus, the relative radiosensitivity of a particular developmental stage is found to be species specific. Under the conditions of these experiments, the imagines of D. melanogaster and D. malerkotliana were not radiosensitive as shown by postirradiation increase in their protein content. (auth)

27117 INSECT STERILIZATION BY IRRADIATION. Glogowski, K. (Instytut Ochrony Roslin, Poznan, Poland). Wiad. Ekol.; 18: 67-77(1972). (In Polish).

At the present time application of sterilized insects to destroy or limit pest populations has reached the stage of studies on its practical use, and it is difficult currently to determine the extent of the scale on which this method is applied in practice. The effectiveness of the method, and its simultaneous selectivity, have roused considerable interest in many countries. Sterility can be caused in insects by different methods, e.g. by the action of low or high temperatures, chemical preparations, hormones, and ionizing radiation. The last of these methods has so far proved to be most serviceable in practical use. A detailed discussion is given of the properties of ionizing rays and their effect on living organisms, and examples are given of sterilization of females and males by radiation. (auth)

27118 RADULA REPLACEMENT AND CELL PROLIFERATION IN THE X-IRRADIATED RADULAR GLAND OF THE SLUG LIMAX FLAVUS L. On the Function of the Radular Gland Epithelia. Kerth, K. (Univ., Wuerzburg, Ger.). Arch. Entwicklungsmech. Organ.; 172: No. 4, 317-348(1973). (In German).

The long-term effect of a single whole-body x irradiation of radula, radula replacement rate, and radular gland of Limax flavus L. was studied. In the course of 8 weeks after irradiation with 50,000 R, two separate damaged areas developed in the radula. Immediately after exposure 1 to 2 transverse rows of defective teeth arise. Posterior to an area with normal transverse rows an extensive zone of malformed teeth develops from the 2nd week on. Normal transverse rows are produced again after the 8th week. Adult snails replace 3 to 3.5 transverse rows/day during 5 weeks after a dose of 40,250 R. The replacement rate decreases to 1.1 rows/day in the 6th week. After irradiation with 50,000 R the proliferation zones of the superior and inferior epithelium differ with respect to the extent of damage. In the first mentioned area, numerous cells die; the cell proliferation is strongly reduced for weeks and reaches a normal level again at the beginning of the 10th week. The superior epithelium and its proliferation zone are inhibited temporarily. The mitotic activity in the inferior epithelium is less reduced than in the superior epithelium. It has almost normalized in the 5th week after exposure. Only a few inferior epithelium cells die; atrophy does not occur. From the 3rd week on after exposure, the odontoblasts in numerous radular glands are deformed. They assume their normal shape again at the beginning of the 10th week. No odontoblasts die after the irradiation. Irradiation of head-shielded snails with 50,000 R showed no effects in the radula or in the radular gland epithelia. The temporary elimination of the superior epithelium and the epithelial region above the odontoblasts-groups does not affect the teeth-formation and the radula transport into the oral cavity. Hence it follows that the odontoblasts-group is exclusively responsible for the definitive shape of the tooth. The radula is transported into the oral cavity by the inferior epithelium. On account of these results, it is possible for the first time to describe comprehensively the division of labor in the radular gland. After irradiation with 50,000 R, an abnormal epithelial system develops from the 2nd week on the tip of the radular gland. It encloses spheric or tube-like cavities. In many cases they communicate with the lumen of the radular gland. The light-microscopic appearance of the cells of this abnormal epithelium resembles those at the tip of a non-irradiated radular gland. (GE)

Radionuclide Effects (Internal Source)

Refer also to abstracts 26709 and 28903.

Man

Refer also to abstracts 26740 and 27059.

27119 RADIOACTIVE IMPURITIES OF NUCLIDE GENERATORS AND ESTIMATION OF RESULTING ABSORBED DOSE IN MAN. Meinhold, H.; Herzberg, B.; Kaul, A.; Roedler, H. D. (Univ., Berlin). pp 39-52 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

The contamination of generator eluates was examined quantitatively as a basis for more accurate dose calculations. In the course of the test program $^{99}Mo/^{99m}Tc$-generators supplied by three manufacturers were studied over a period of three years. In addition $^{87}Y/^{87m}Sr$- (one supplier) and $^{113}Sn/^{113m}In$-generators (one supplier) were checked for radioactive impurities. For this purpose the generators were eluted under constant conditions. The generator column as well as the eluates were measured by gamma spectrometry. Pulse-height analysis was performed by means of a 4096-channel analyzer connected to a well-type Ge(Li)-detector. Dose calculations were performed according to the MIRD concept of absorbed fractions, which was originally developed for specified pairs of source and target organs, but was not extended to the absorbed dose because of the radioactivity distributed within the remaining parts of the body. In the $^{99}Mo/^{99m}Tc$-generator columns the following radionuclides were observed: ^{60}Co, ^{65}Zn, ^{92}Nb, $^{95}Zr/Nb$, ^{110m}Ag, ^{124}Sb, ^{134}Cs, ^{192}Ir. In the eluates only ^{134}Cs and in some cases ^{110m}Ag could be detected. To evaluate the degree of breakthrough of these radionuclidic impurities, the activity of each contaminant of the eluate was referred to that of the generator column. To estimate the amount of radiation dose from the contaminants in eluates in $^{99}Mo/^{99m}Tc$-generators in relation to the total absorbed dose, the activity of each radiocontaminant was calculated per injected mCi ^{99m}Tc. The results indicate that the dose distribution from ^{134}Cs can reach 50 to 85% of the dose from ^{99m}Tc. The contribution of ^{110m}Ag is of less importance. Contributions to the radiation burden from radioactive contaminants in eluates of $^{87}Y/^{87m}Sr$- and $^{113}Sn/^{113m}In$-generators have not been estimated so far because identification of the corresponding radionuclides is not yet possible. (auth)

27120 EFFECT OF TRACER DOSES OF RADIOPHARMACEUTIC SUBSTANCES LABELED WITH GOLD (^{198}Au), INDIUM (^{113}In) AND MERCURY (^{203}Hg) ON BLOOD CLOTTING. Raiciulescu, N.; Stoichita-Papilian, M.; Niculescu-Zinca, D. Rev. Roum. Med. Interne; 9: No. 5, 475-490(1972).

Blood clotting was investigated in 79 patients before and after administration of radiopharmaceutic substances labeled with ^{113m}In and ^{198}Au for liver scanning and of chlormerodin-^{203}Hg for kidney scanning, as well as in 16 normal controls who received unlabelled colloidal iron. The different changes of the blood clotting factors and of the coagulation process were interpreted as depending on the target organ of the radioisotope. The blood clotting changes, though significant, have no clinical manifestation since the deficits of coagulation factors are partial and compensate each other. (auth)

27121 CHROMOSOME BREAKAGE IN HUMAN PERIPHERAL LYMPHOCYTES AFTER RADIOACTIVE IODINE (^{125}I) TREATMENT. Boyd, E.; Ferguson-Smith, M. A.; McDougall, I. R.; Grieg, W. R. (Royal Hospital for Sick Children, Glasgow). Radiat. Res.; 57: No. 3, 482-487(Mar 1974).

Recent interest in the use of ^{125}I (half-life 60 days) in preference to ^{131}I (half-life 8 days) in the treatment of thyrotoxicosis has prompted studies of possible undesirable extrathyroidal radiation damage. The frequency of chromosome breakage in peripheral lymphocytes is one measure of this damage. A study in patients treated with ^{125}I is described which shows as high a frequency of chromosome aberrations as is found after ^{131}I therapy. The implications of this observation are discussed. (auth)

27122 METHOD OF ESTIMATING THE IRRADIATION OF CRITICAL ORGANS OF MAN IN CASE OF ENTRY INTO THE BODY OF FISSION FRAGMENTS. Prokofiev, O. N.; Dzyubenko, I. I.; Brivin, G. A. Gig. Sanit.; No. 10, 108-110(Oct 1973). (In Russian).

Formulas are given which can be used to find, without complex calculations, the activity of fission fragments of a given age on the first day of their introduction into the human organism and up to 5 years later. (TTT)

Animals

Refer also to abstract 27077.

27123 (AEC-tr-7507, pp 124-128) MITOTIC SYSTEM AND SYNTHESIS OF DNA OF LYMPHOCYTES OF THE THYMUS AND MEDIASTINAL LYMPH NODE IN RATS AFTER INTERNAL IRRADIATION. Khussar, Yu. P.; Lushchikov, E. P. (Tartu State Univ., USSR). 1973. Translated from Radiobiologiya; 13: No. 5, 744-747(1973).

In Radiobiology.

The proliferative activity of lymphocytes of the thymus and mediastinal lymph node was investigated histologically and autoradiographically on 76 adult male white rats. It was established that internal irradiation with ^{144}Ce induces qualitatively monotypic, pronounced alterations of the proliferating lymphoid cells of the thymus and lymph nodes. Five days after incorporation of ^{144}Ce in both lymphoid organs, the number of mitoses and lymphocyte nuclei labeled with ^{3}H-thymidine is reduced 3 to 4-fold; up to the end of the investigated period (45 days), recovery is incomplete. Four to six days after irradiation, the generation time of the lymphoid cells of the lymph node is sharply lengthened; the premitotic phase is 22 hrs instead of the normal 1 to 2 hrs. (tr-auth)

27124 LABELLING OF LYMPHOCYTES WITH ^{211}At AND ITS APPLICATION IN TRANSPLANTATION. Neirinckx, R. D. (Council for Scientific and Industrial Research, Pretoria); Myburgh, J. A.; Smit, J. A. pp 171-181 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

Organ transplantation is seriously hampered by the defence mechanism of the recipient. This mechanism is based on the specific recognition and destruction of non-self antigens by host lymphocytes, resulting in the rejection of the transplanted organ. Suppression of these rejection processes can be effected by non-specific destruction of host lymphocytes, leading to a reduction of recipient defence capabilities against infections. Specific elimination of immunocompetent lymphocytes, however, avoids this often lethal side-effect. A method is described that tries to achieve selective immunosuppression by killing the immunocompetent lymphocytes by means of an ^{211}At-labelled antigen, in our case the lymphocytes of the organ donor. First, a suitable electrolytic labelling procedure was developed. The optimum conditions as regards potential difference and labelling time were determined, and the destruction by α radiation of the labelled lymphocytes themselves was studied as a function of the waiting period after the labelling. Experiments with mixed lymphocyte cultures (MLC) were needed to determine whether the labelled lymphocytes could knock out the responding lymphocytes. The stimulatory cells were labelled with ^{211}At and were treated with mitomycine to ensure a one-way transformation of the lymphocytes. After 6 days of incubation the inhibition in stimulation of the lymphocytes was matched with that of non-treated cells, and 0.1 to 1 μCi of ^{211}At per 2.10^6 cells gave inhibitions of 20 to 100%. This result was very encouraging for the next step, the application of the method to liver-transplant patients. For these experiments a group of 9 baboons had their livers transplanted and were treated in graded sequence within 2 hr after transplantation with 10^9 to 5.10^9 donor lymphocytes labelled with 12 to 750 μCi of ^{211}At. The survival times of these baboons were compared with those of a test group of untreated baboons which received liver transplants. The mean survival time, ± standard error of the mean, was 35.6 days ± 6.2 days for the ^{211}At-treated baboons, whereas it was only 12.9 days ± 2.5 days for the untreated ones. The program is being continued in an effort to improve on these results. (auth)

27125 CHROMOSOMAL BONE-MARROW DAMAGES AFTER INCORPORATION OF RADIOPROMETHIUM IN MICE. Grigoroff, L. A.; Hoelzer, F.; Gensicke, F. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Radiobiol.-Radiother.; 14: No. 6, 695-702 (1973). (In German).

After intraperitoneal application of 1.0, 1.5, and 2.0 μCi ^{147}Pm/g body weight, the bone-marrow of mice was karyologically examined. From 1.5 μCi ^{147}Pm/g, an increase of one- and two-break aberrations as well as of breaks per cell is observed. Chromosomal changes do not show important aberrations with the same amount of radioactivity at different periods after application, up to 30 days. The results are discussed in detail by means of autoradiographic findings. (auth)

27126 TOXICITY OF $^{90}Sr-^{90}Y$ IN CHINESE HAMSTERS. Brooks, A. L.; Benjamin, S. A.; McClellan, R. O. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). Radiat. Res.; 57: No. 3, 471-481(Mar 1974).

Strontium-90 citrate was injected intraperitoneally into Chinese hamsters at activity levels of 0.2, 0.5, 1.0, 2.0, 3.0, and 5.0 μCi/g body weight and the animals held for lifespan observation. Additional hamsters injected with sodium citrate served as controls. When compared with controls, a

lifespan shortening that increased with increasing ^{90}Sr levels was observed in all ^{90}Sr-injected animals. Animals that received 3.0 or 5.0 μCi/g died within the first 2 weeks postinjection. Those in the other activity level groups had 50% survival rates at 90 days after 2.0 μCi/g, 260 days at 1.0 μCi, 700 days at 0.5 μCi, 900 days at 0.2 μCi, and 1100 days for controls. Three osteosarcomas were found, all in animals injected with 1.0 μCi/g, a level of activity known to produce a high incidence of bone tumors in the mouse. The results suggest that the Chinese hamster is more resistant to bone tumor induction than is the mouse. A high incidence of myeloproliferative disorders was found both in older control and ^{90}Sr-injected animals. (auth)

Plants

27127 (AEC-tr-7507, pp 44-50) EFFECTIVENESS OF THE CYTOGENETIC ACTION OF ^{90}Sr, INCORPORATED INTO CREPIS CAPILLARIS SEEDS. Kaplan, I. S.; Tikhomirov, F. A.; Khvostova, V. V. (Moscow State Univ.). 1973. Translated from Radiobiologiya; 13: No. 5, 686-690(1973).

In Radiobiology.

A comparison of the cytogenetic effect of external and internal irradiation from a source of $^{90}Sr + ^{90}Y$ on somatic cells of Crepis capillaris was made. The effectiveness of the β radiation of incorporated ^{90}Sr, calculated per unit dose, is 20 times as great as that of external irradiation from the same source. The observed difference is probably associated with a transmutation effect. A consideration of chromosome damages according to type showed an increase in two-hit aberrations with increasing dose. (tr-auth)

27128 EFFECT OF SEED TREATMENT WITH ^{32}P ON CAPE-GOOSEBERRY. Pandey, V. S. (Government Fruit Research Station, Chaubattia, India). Progr. Hort.; 3: No. 1, 37-50(1971).

Seeds of Cape-Gooseberry (Physalis peruviana L.) were soaked in ^{32}P in the form of $H_3P^{32}O_4$ in dilute HCl for 48 hr. The doses of seed treatment were 5, 10, 15, 20, 25, and 30 μ Cl/seed for internal β-irradiation. The germination and flowering of plants were considerably delayed and the growth and fruiting were reduced with the increase in dose. The treatments of 25 and 30 μ Ci proved completely lethal, while 20 μ Ci showed only 2% survival. The survival in 10 μ Ci treatment was 44.66%. The same decreasing trend was observed in total number of anaphases scored in 10 μ Ci treatment. The total morphological abnormalities were correlated with anaphase and abnormalities increased as the dose increased. The 10 μ Ci treatment proved better as regards induction of abnormalities because there were abnormalities in growth behavior as compared with other treatments. There was 50% reduction in the plant population showing virus symptoms with 5 μ Ci treatment and after that no symptoms were observed. (Indian Sci. Abstr.)

Nuclide Kinetics and Toxicology

Refer also to abstract 28902.

Man

Refer also to abstracts 27156, 27157, and 27181.

27129 BOURGES RADIOACTIVITY DECONTAMINATION CENTER. Weiss. (Association de Protection Civile, Bourges, France). Prot. Civ. Secur. Ind.; No. 223, 60-61(Sep 1973). (In French).

The Bourges radioactivity decontamination center is concerned with the civil and military aspects of research on protection against contamination from radioactive fallout (^{140}La and ^{210}Po) or chemical spreading. The center also deals with the training of European army personnel (in the domain of cleaning vehicles and armaments and other objects having crossed radioactive zones). The risks and the health physics measurements made are briefly discussed. (FR)

27130 QUANTITATIVE UPTAKE MEASUREMENTS WITH A SHADOW SHIELD WHOLE-BODY COUNTER. Blake, K. C. H.; Hering, E. R. (Groote Schuur Hospital, Cape Town). S. Afr. Med. J.; 47: 1066-1068(23 Jun 1973).

A simple procedure is described for the calibration of a shadow shield whole-body monitor to determine the absolute amount of a radioisotope at various body sites of a patient. It is possible to measure the turnover of the isotope in different tissues from day to day, or to compare the uptake of successive doses of isotope at various body sites over a longer period of time. In the case of patients receiving ^{131}I for treatment of thyroid carcinoma it is often useful to know the percentage of the dose given which has been concentrated in a particular site. (auth)

27131 EMPIRICAL FORMULA FOR ESTIMATING EFFECTIVE TISSUE THICKNESS IN THE ASSESSMENT OF PLUTONIUM IN LUNG. Shirotani, T. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 10, 647-649(Oct 1973).

An empirical formula is derived for estimating the effective tissue thickness of exposed subjects in relation to plutonium assessment in the lungs. There is good agreement between the estimates obtained using the formula and the experimental results of two different investigators. (ERB)

Animals

Refer also to abstracts 26717–26719, 26829, 27167, 27171, and 28908.

27132 (INIS-mf-726) ELIMINATION OF ^{90}Sr AND ^{137}Cs IN SHEEP MILK. Vrigazov, A.; Marinov, V. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 11p. (In Bulgarian). INIS.

From 2nd national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Investigations were carried out by means of balance experiments with sheep on the elimination of ^{90}Sr and ^{137}Cs with the milk, feces, and urine after feeding the animals with naturally contaminated hay. It was ascertained that the radioactive equilibrium in the organism occurs on the sixth day from the beginning of the feeding with contaminated hay. In the total amount of milk are eliminated 1.75% of ^{90}Sr and in 1 liter, 0.99% on an average per day as the discrimination factor milk-fodder is 0.16 in sheep. In the feces are eliminated on an average 84.20% and in the urine 3.5% of ^{90}Sr. In the total milk yield are eliminated 5.05% on an average per day of the amount of ^{137}Cs assimilated from the fodder and 2.79% in 1 liter of milk. With the feces are eliminated 56.10% and with the urine, 63%. (auth)

27133 MEASUREMENT OF TRANSIT IN THE GASTROINTESTINAL TRACT USING ^{198}Au-COLLOID. Shibata, H. (National Inst. of Radiological Sciences, Chiba, Japan). Radioisotopes (Tokyo); 22: No. 7, 360-365(Jul 1973). (In Japanese).

This study was undertaken to clarify the suitability of ^{198}Au-colloid and $Na_2\,^{51}CrO_4$ for a marker of transit in the gastrointestinal tract. The distribution, the excretion into the feces and urine, the absorption, and excretion through the gastrointestinal tract were investigated in mice by means of sample measurement and whole-body autoradiography. Orally administered ^{198}Au-colloid was not absorbed from the gastrointestinal tract and all was excreted into the feces. ^{198}Au-colloid was not adhered to the gastrointestinal mucosa and consequently, the excretion into the feces was not delayed. On the other hand, orally administered $Na_2\,^{51}CrO_4$ was relatively well absorbed from the gastrointestinal tract, distributed to the whole body and a part of it was excreted into the urine. Intravenously injected $Na_2\,^{51}CrO_4$ was excreted into the gastrointestinal tract. It is concluded from the results obtained that ^{198}Au-colloid is available for a marker of gastrointestinal transit but $Na_2\,^{51}CrO_4$ is unavailable. (auth)

27134 CRITICAL ASSESSMENT OF CHANGES IN THE PULMONARY CIRCULATION FOLLOWING INJECTION OF LUNG SCANNING AGENT (MAA). Allen, D. R.; Nelp, W. B.; Hartnett, D. E.; Cheney, F. W. (Univ. of Washington, Seattle). pp 37-42 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol.2); CONF-730309-P2.

In conjunction with evaluating new lung scanning agents, a detailed model for the study of the physiological effects of macroaggregated albumin (MAA) on the lung and pulmonary circulation was established. Studies were designed to measure the minimum toxic dose as well as to observe subtle effects of the usual lung scan dose in dogs with elevated pulmonary artery pressure and pulmonary vascular resistance due to previous microembolism. Macroaggregated albumin particles with stannous chloride were prepared by pH adjustment and heat denaturation of human serum albumin (HSA). Final particle size was accomplished either by forced flow under controlled conditions through a 0.2 mm-aperture or by length of heating time and agitation. The average particle size in these studies was 30 to 50 μm. Studies were done on eleven 15 to 25 kg mongrel dogs with controlled ventilation and

pentobarbital anaesthesia. On-line monitoring of the following variables was performed: pulmonary and systemic arterial pressure, pulmonary arterial wedge pressure, electrocardiogram, cardiac output, airway pressure, arterial and mixed venous blood gases, physiologic dead space, venous admixture, and systemic and pulmonary vascular resistance. In all instances, a single dose of 1×10^8 particles (usual human lung scan dose (LSD)) produced no detectable change in the normal dog. Doses of 1.7×10^8 particles per kilogram body weight, however, characteristically caused a 10 to 20% increase in mean pulmonary artery pressure for 10 to 20 min. With larger doses, pulmonary vascular resistance routinely increased, and doses of 20×10^8 particles per kilogram body weight produced fatal reactions. After dogs developed sustained pulmonary hypertension from repeated microembolization, the injection of an additional LSD showed no further measurable deterioration in the multiple variables measured. It was concluded that the usual human LSD produced no measurable effect in the normal or abnormal dog. Based on extrapolations related to body weight, the minimum dose in man expected to increase the pulmonary artery pressure is approximately 125 times the usual LSD. The most sensitive indicator of toxic effect is pulmonary artery pressure followed by pulmonary vascular resistance. Arterial pressure, wedge pressure and PaO_2 were usually normal until fatal embolization. (auth)

27135 DISTRIBUTION OF ^{14}C PCBs IN CARP. Yoshida, T.; Takashima, F.; Watanabe, T. (Tokyo Univ.). Ambio; 2: No. 4, 111-113(1973).

Carbon-14-labeled organic chlorine compounds (PCB) were administered to carp both through the diet and by exposure to contaminated water. Distribution of (^{14}C) PCBs in the tissues and organs was observed by means of whole body autoradiography and more quantitatively estimated by liquid scintillation. A distinctive distribution pattern was observed involving the following: gall bladder, adipose tissue of skull, hepatopancreas, and other lipid rich tissues. (auth)

27136 INCORPORATION OF ^{32}P INTO THE BLOOD AND SUPRARENAL GLAND OF THE RAT. Kovacs, V.; Kadar, L. (Babes-Bolyai Univ., Cluj). Kiserl. Orvostud.; 25: No. 4, 418-420(Aug 1973).

A total of 70 male rats, weighing 130 g each, were administered 0.5 μCi $Na_2H^{32}PO_4$ intraperitoneally in conjunction with standard diet. Groups of animals were decapitated 2 hours after administration of the radioactive phosphorus, and other groups were decapitated subsequent to irradiation with 200 to 800 R x-rays at various periods preceding or following the administration. The concentration of ^{32}P was determined in the blood and in the suprarenal gland. The isotope concentration increased 2 hours after administration of the ^{32}P in the gland, and there was evidence of a resistance reaction if there was subsequent x-ray irradiation of the whole body. All irradiated animals showed a significant decrease in the plasma/blood ^{32}P ratio after irradiation. (JPRS)

27137 EVALUATION OF RADIOMETRIC MEASURES OF THE BODY SURFACE OF ANIMALS TO DETERMINE THE RATE OF RADIOACTIVE CONTAMINATION OF MUSCLES AND INTERNAL ORGANS WITH ^{134}Cs. Jaworek, D.; Szulc, M. (Agricultural Univ., Warsaw). Med. Wet. (Poland); 28: 557-559(1972). (In Polish).

Determination of internal contamination with radioactive substances by means of external radiometric measures of the body surface was investigated. The experiments were carried out on rabbits which were given ^{134}Cs intragastricly. The animals were examined with a radiometer ML-57 every day. Rabbits were also killed after 2, 4, 7, 10, 24, and 31 days following the experimental contamination and internal organs and samples of muscles were taken to determine the content of ^{134}Cs. It was found that there was a distinct correlation between the external measurements and the activity of ^{134}Cs in muscles, especially between 0 to 24 days following the radioactive contamination. It was concluded that in case of large animals the results should be even more reliable as the probe applied to thicker layers of muscles would not measure the radioactivity coming from internal organs, in which the content of Cs in the first days after radioactive contamination was relatively high. (auth)

27138 UPTAKE OF ^{32}P IN THE PINEAL GLAND, SUPERIOR CERVICAL GANGLIA, AND HYPOPHYSIS OF THE RAT IN RELATION TO THE TIME OF DAY. Karasek, M.; Oginski, M.; Surma, M.; Pawlikowski, M. (Medical Academy, Lodz, Poland). Endokrynol. Pol.; 23: 247-251(1972). (In Polish).

The uptake of ^{32}P in the pineal body, superior cervical ganglia, and anterior and posterior lobe of the pituitary gland of the rat the end and onset of darkness period, e.g. at 6 am and 6pm, was investigated. The decrease of the uptake of ^{32}P in all investigated organs was observed at 6 pm. In the anterior and posterior lobe of hypophysis this decrease was statistically significant. (auth)

27139 ^{11}C DISTRIBUTION IN DOGS VISUALIZED IN SITU AFTER INTRAVENOUS ^{11}C-CYANIDE IN HIGH SPECIFIC ACTIVITY. Myers, W. G. (Ohio State Univ., Columbus); Lamb, J. F.; James, R. W.; Winchell, H. S. W-7405-ENG-48; AT(04-3)-849. Nucl.-Med.; 12: No. 2, 154-162(31 Aug 1973). (LBL-2620).

^{11}C-cyanide is produced automatically and continuously, at the rate of hundreds of millicuries per hour, by bombarding gas targets consisting of 99% nitrogen and 1% hydrogen, with 15-MeV protons. Whole-body scintiscanning showed ^{11}C localized regularly in the heart, fundus of the stomach, and the kidneys of dogs under deep pentobarbital anesthesia, within minutes to an hour after intravenously injecting ^{11}C-cyanide in high specific activity. Carbon-11 also accumulated similarly in the parotid glands and in the testes of some of the dogs, but these were inconstant findings. (auth)

27140 METABOLISM AND BIOLOGICAL EFFECTS OF THE TRANSPLUTONIUM ELEMENTS. Durbin, P. W. Contract W-7405-eng-48. pp 739-896 of Handbook of Experimental Pharmacology. New Series. Vol. 36. Hodge, H. C. (ed.). New York; Springer-Verlag (1973).

Data are reviewed from studies on the metabolism and toxicity of transplutonium elements with emphasis on uptake and retention in mammals. Data are also included on uptake by bacteria, yeasts, fungi, algae, lichens, plants, sea weeds, marine invertebrates, fish, insects, and birds. Data on mammals includes tissue distribution, excretion, and retention in bone tissues, lungs, liver, and body fluids, and binding by blood proteins, following ingestion, inhalation, intratracheal administration, skin absorption, or intestinal absorption of ^{241}Am, ^{140}La, ^{144}Ce, ^{142}Pr, ^{147}Nd, ^{147}Pm, ^{239}Pu, ^{242}Cm, ^{244}Cm, ^{249}Bk, ^{249}Cf, ^{253}Cf, and ^{253}Es. The effects of EDTA and DTPA on excretion are also discussed. Some data are included on the internal radiation dose response for carcinogenesis and other pathological changes in mammals. (325 references) (CH)

27141 DISTRIBUTION OF RUBIDIUM-86 IN THE SPLANCHNIC AREA DURING AND AFTER PHENOBARBITONE ADMINISTRATION. Ohnhaus, E. E. (Sandoz AG, Basel). Arzneim.- Forsch.; 23: No. 9, 1339-1341(Sep 1973).

Blood flow studies on different splanchnic organs following phenobarbitone administration were done in rats utilizing the ^{86}Rb-distribution method of Sapirstein. The percentage of the original dose of $^{86}RbCl$ found in pancreas, stomach, spleen, duodenum, jejunum, ileum, liver, and kidney was estimated 24 hr after cessation of daily (1 to 4 days) dosing with phenobarbitone (30 mg/kg) and also at different time intervals (48, 96, and 120 hr) following 4-day treatment with phenobarbitone. There was a significant decrease of ^{86}Rb uptake in the pancreas, liver, and kidney. The rest of the organs investigated showed no difference. The time course was similar to changes in liver weight, sleeping time, and microsomal enzyme activity found in previous experiments. Whether this decrease of ^{86}Rb uptake is representative of the true blood flow values seems doubtful, knowing the limitations of the ^{86}Rb method and comparing former results of liver blood flow measurements following phenobarbitone administration utilizing a heat exchange method. A change of the extraction ratio in the three organs and, as a result, an underestimation of the true blood flow values is probably explained by changes in pool size due to the enhanced microsomal protein content in the cells. (auth)

27142 BLASTOGENIC INFLUENCE OF ^{45}Ca IN RELATION TO THE FUNCTIONAL CONDITION OF PARATHYROID GLAND. Dobroskok, A. I.; Likhmarev, I. A.; Arkhangelv'skaya, G. V.; Krasnoshchekova, G. P. (Leningrad Research Inst. for Radiation Hygiene and Ministry of Health Care). Med. Radiol.; 18: No. 12, 17-22(Dec 1973). (In Russian).

In experiments on albino mice the osteoblastogenic influence of ^{45}Ca was noted both on healthy animals and those with disorders of regular activity of the parathyroid gland or without them. It was shown that in combined influence of ^{45}Ca and hormone, the frequency of exposure of bone tissue tumors is significantly higher than those under the influence only of ^{45}Ca. Simultaneously it was established that in mice subjected to parathyroidectomy, on the contrary, only insignificant osteo-blastogenesis was observed in comparison with the group given only ^{45}Ca. (auth)

27143 KINETICS OF RUTHENIUM-106 METABOLISM IN THE LIVERS OF RATS AND ITS BINDING BY BODY PROTEINS. Voevodina, T. M.; Fedorova, A. V. Gig. Sanit.; No. 10, 110-111 (Oct 1973). (In Russian).

Data obtained from studies on the livers of white rats given ^{106}Ru perorally or intraperitoneally indicated that the radioisotope is removed from the body in two periods. The first 70 to 80% is removed in the first 5 days, and there is additional removal in the second period, at about 45 days. Within 3 hr after administration, the ruthenium is practically completely bound to the protein. After one day, 40% is bound to the albumens, 30% to the euglobulins, and 12% to the pseudoglobulins, ferritin, and

slightly soluble proteins. After 3 to 10 days the amount of ^{106}Ru bound to protein decreased, with only traces remaining after 20 days. In the first period apparently the ^{106}Ru is bound to the albumen and pseudo- and euglobulin, and in the second, to the ferritin and slightly soluble protein. (TTT)

Microorganisms

27144 EFFECT OF CELL SIZE ON THE REACTION OF URANIUM ACETATE, MERCURIC CHLORIDE, AND CYANOGEN IODIDE WITH A STRAIN OF PSEUDOMONAS AERUGINOSA. Bernheim, F. (Duke Univ. Medical Center, Durham, NC). Microbios; 4: 87-92(Sep 1971).

The effects of uranium acetate, with and without the addition of NaCl, on the optical density and size of cells of Pseudomonas aeruginosa were compared with the effects of mercuric chloride and cyanogen iodide with and without the addition of NaCl. The addition of uranium acetate to the culture media caused the cells to swell rapidly, with the extent of the change dependent upon the time uranium was allowed to react with the cells before the addition of NaCl. A partial reversal of the effect of uranium on swelling was obtained by the addition of ATP or sodium phosphate. Both mercuric chloride and cyanogen iodide caused the cells to swell but the addition of phosphates had no effect on the amount of swelling. (CH)

New Tracer Techniques

Refer also to abstracts 26705, 26709, 26714–26720, 26724, 26727, 26729, 26730, 26732–26734, 26736, 26738, 26741, 26742, 26767, 26881, 27102, 27103, 27119, 27120, 27134, and 27462.

27145 (CEA-CONF-2483) DYNAMIC AND QUANTITATIVE EXPLORATIONS IN HEPATOLOGY WITH THE GAMMA CAMERA. Desgrez, A. (CEA, 91-Orsay (France). Service Hospitalier Frederic Joliot). 1973. 30p. (In French). (CONF-730681-1). Dep. NTIS (U. S. Sales Only) $3.50.

From fifteenth French symposium on nuclear medicine; Louvain, Belgium (1 Jun 1973).

The use of the gamma camera for scintigraphic dynamic studies and quantitative exploration of the liver is described in a general manner. The distribution of ^{198}Au-colloids, ^{131}I-Rose Bengal, ^{99m}Tc-albumin microphores, and ^{75}Se-bleomycin in relation to pathological condition of the liver is reported. (39 references) (JSR)

27146 (FDA-74-8012) SCIENTIFIC SEMINARS OF NUCLEAR MEDICINE. Laboratory Dedication, Cincinnati, Ohio, May 4–5, 1972. Van Tuinen, R.; Scholz, K. L. (Food and Drug Administration, Rockville, Md. (USA)). Nov 1973. 54p.

Separate abstracts were prepared for the two nuclear medicine seminars contained in this publication. (CH)

For abstracts of individual sections see: 27147 and 27148.

27147 (FDA-74-8012, pp 1-31) PRODUCTION OF RADIONUCLIDES AND PREPARATION OF RADIOPHARMACEUTICALS: PANEL DISCUSSION. Sodd, V. J. (Food and Drug Administration, Cincinnati, OH). Nov 1973.

In scientific seminars of nuclear medicine.

The importance of organ-specific radiopharmaceuticals labeled with short-lived radionuclides for reduction of the radiation dose to patients during scintiscanning is reviewed. The uses of cyclotrons for the production of biologically active short-lived radionuclides are discussed and the production of radionuclides at a number of medical cyclotrons is described. Cyclotron produced radionuclides potentially useful for metabolic and diagnostic studies include: ^{15}O, ^{11}C, ^{18}F, ^{52}Fe, ^{49}Cr, ^{81}Rb, ^{111}In, ^{13}N, ^{42}K, ^{67}Ga, ^{68}Ga, ^{77}Br, ^{87m}Sr, ^{123}I, and ^{129}Cs. (CH)

27148 (FDA-74-8012, pp 35-44) NEW VISTAS IN NUCLEAR MEDICINE: PANEL DISCUSSION. Adelstein, S. J. (Harvard Medical School, Boston, MA). Nov 1973.

In scientific seminars of nuclear medicine.

The need for multidisciplinary effort to achieve the potential diagnostic usefulness of scintiscanning is discussed. The development of radiopharmaceuticals labeled with cyclotron produced short-lived radionuclides to reduce the radiation dose to patients is postulated. (CH)

27149 (STI/PUB-344(Vol.2)) RADIOPHARMACEUTICALS AND LABELED COMPOUNDS. Volume II. Proceedings Series. Proceedings of the Symposium Held in Copenhagen, Denmark, March 26–30, 1973. (International Atomic Energy Agency, Vienna (Austria)). Nov 1973. 352p. (In French and English). (CONF-730309-P2). IAEA $16.00.

Separate abstracts were prepared for the 25 papers included. (CH)

For abstracts of individual papers see: 26648, 26732–26742, 26767, 27124, 27134, and 27156–27165.

27150 INTERACTION OF METHYL MERCURY WITH ERYTHROCYTES. White, J. F.; Rothstein, A. (Univ. of Rochester, NY). Toxicol. Appl. Pharmacol.; 26: 370-384(1973). (UR-3490-165).

The uptake and release of ^{203}Hg-labeled methyl mercury by red blood cells of the human adult was studied and some comparisons were made with human fetal and rat erythrocytes. Over the concentration range studied a rapid and virtually complete uptake followed exposure of erythrocytes to the mercurial. Methyl mercury distributes proportionately between intra- and extracellular hemoglobin, and various sulfhydryl agents elicit release from the cell, thus demonstrating the reversibility of binding. The rate of release to bovine serum albumin is inversely proportional to the amount of mercurial bound to the cell and to the period of incubation suggesting some form of intracellular compartmentation. Cysteine alone induces a transient release of methyl mercury from the erythrocyte but does not facilitate equilibrium with albumin. Rat red cells release much less methyl mercury to albumin than human red cells. This tighter binding could not be accounted for by differences in intracellular distribution of the mercurial or affinity for the respective hemoglobins from stroma-free hemolysates. No obvious differences in binding were observed between human adult and fetal red cells. (auth)

27151 OPTIMIZATION OF A NEW KIT-PREPARED SKELETAL-IMAGING AGENT, ^{99m}Tc–Sn–EHDP, COMPARED WITH ^{18}F. Wellman, H. N. (Indiana Univ., Indianapolis); Browne, A.; Kavula, M.; Khairi, R.; Anger, R.; Tofe, A. J.; Francis, M. D. pp 93-108 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

A new simple bone imaging agent, distannous ethane-1-hydroxy-1, 1-diphosphonate combined with ^{99m}Tc(^{99m}Tc-Sn-EHDP) was compared with $Na^{18}F$ in a series of 30 patients. Images were obtained after intravenous injection of 10 to 15 mCi of ^{99m}Tc-Sn-EHDP at 1, 2, and 3 h post-administration with both rectilinear and gamma-scintillation camera instrumentation. Subsequently, rectilinear skeletal imaging was performed in each patient with 3 mCi $Na^{18}F$ 3 hr post administration. Experience with the bone imaging kit demonstrated a high degree of dependability in labelling, more so than reported with polyphosphate compounds. In the initial five patients, serial blood, faecal, and urine samples were analyzed for residual activity. Mean 24-hr biological retentions in the bones of 50% were found. Radiation dosimetry based on these data is reported. An absorbed skeletal dose of 0.041 rad per administered mCi was found for ^{99m}Tc-Sn-EHDP. The ^{99m}Tc-Sn-EHDP scans were compared with the ^{18}F images of all patients. Approximately twice the number of lesions were observed using ^{99m}Tc-Sn-EHDP complex as using ^{18}F. In addition, the lesions were usually seen with greater clarity with the ^{99m}Tc-Sn-EHDP especially in the ribs, vertebrae, and skull. Thus, kit-prepared ^{99m}Tc-Sn-EHDP appears to be a new, economical, rapidly prepared, convenient and efficacious agent for improved resolution scintillation imaging skeletal surveys. (auth)

27152 ^{99m}Tc VERSUS ^{18}F BONE-SCANNING AGENTS: ADVANTAGES AND DISADVANTAGES. Quinn, J. L. III; Crews, M. C.; Westerman, B. R. (Northwestern Univ., Chicago). pp 119-126 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

The use of the bone scan in the search for metastases is widely accepted and growing rapidly. In a great measure this growth is due to the availability of short-lived nuclides with high photon yields, namely ^{18}F and ^{99m}Tc. Neither of these nuclides nor the radiopharmaceuticals proposed are ideal for every laboratory and every situation. ^{99m}Tc is generally more readily available for daily, on-site radiopharmaceutical manufacturing and less expensive than ^{18}F, which is ordinarily cyclotron produced and has special problems of daily supply. The physical half-life of ^{99m}Tc is more favorable and its 140-keV energy is more efficiently adaptable to camera recording. The decay of the shorter half-life ^{18}F during the period of imaging is a disadvantage but its 511-keV gamma ray, because of the decreased scatter fraction, is more useful in cases of patients who are obese, have ascites or are in plaster casts. $Na^{18}F$, carrier free, consistently gives reproducible bone images. ^{99m}Tc polyphosphate distribution varies from batch to batch. It is not clear whether this is a function of specific ac-

tivity, chain length or both. Renal and bladder concentration of ^{18}F can be reasonably controlled with dehydration, but the ^{99m}Tc compounds routinely show renal concentrations that can interfere with interpretation of adjacent bone. An additional problem with ^{99m}Tc bone-scanning agents relates to the search for metastases. It is not unusual to perform brain, liver, and bone scans on the same patient during the pre-operative work-up. With customary doses of ^{99m}Tc for brain and liver scanning as much as 15 mCi of ^{99m}Tc at 24 h and 100 μCi at 48 h may remain intra-abdominally. Such a work-up could be completed the same day using ^{18}F for the bone scan but be delayed for up to 72 h using ^{99m}Tc compounds. Although no untoward reactions have been reported to date with the ^{99m}Tc polyphosphate, it is conceivable that the chelating action of 100-200 mg could cause a problem with elderly patients who are cardiovascularly fragile. ^{18}Na has no pharmacologic action at the concentrations administered. (auth)

27153 ^{123}I FOR APPLICATIONS IN DIAGNOSIS. Myers, W. G. (Ohio State Univ., Columbus); Anger, H. O.; Lamb, J. F.; Winchell, H. S. pp 249-256 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

The physical properties of 13-hr ^{123}I make it the ideal radionuclide among the 30 nuclides of iodine for most uses in diagnosis. The 84% of 159-keV γ rays have half-thicknesses in water of 4.7 cm, in NaI of 0.37 cm, in lead of 0.037 cm. The calculated photopeak detection efficiency in the 1.3-cm-thick NaI crystal of the Anger Camera is ≈90%, which is ≈ three-fold greater than for the 364-keV γ rays of ^{131}I. Unfortunately, ^{123}I emits any one of five additional γ rays having energies in the 274-530-keV range, in ≈30% of the disintegrations. ^{123}I emits no β particles, and the average energies of the conversion and Auger electrons are low relative to those of the β particles of ^{131}I; localized radiation exposures from ^{123}I cannot exceed several percent of those from ^{131}I. The 19-hr average life closely matches the times usually involved in studies of iodine metabolism. Thus, not only is radiation greatly reduced further, but repetitive and confirmatory studies thereby are facilitated. Moreover, the low radiation from ^{123}I gives less cause for concern in conventional uptake studies; and even routine imaging of its distribution may be contemplated as an important additional advantage. Thus, much more informative thyroid evaluation studies become feasible, to supplant the limited usefulness of simple ^{131}I "uptake" measurements. Images made with the pinhole camera demonstrate superior resolution to those obtainable with ^{131}I. ^{123}I lacks four of the neutrons of stable ^{127}I. This neutron deficiency requires cyclotrons or other accelerators to generate it. These now are being used to produce ^{123}I in a variety of nuclear reactions, and in purities adequate for use clinically. One supplier bombards ^{122}Te (enriched to greater than 95%) with deuterons to provide ^{123}I that is contaminated at the time of calibration with only ≈2% of a combination of ^{124}I, ^{126}I, ^{130}I and ^{131}I. A dose of 100 μCi of this ^{123}I, and its contaminants, gives a maximum exposure of less than 6 rads to the thyroid gland and 20 mrads to the whole body. (auth)

27154 EVALUATION OF AMINO-ACIDS LABELLED WITH ^{18}F FOR PANCREAS SCANNING. Taylor, D. M.; Cottrall, M. F. (Inst. of Cancer Research, Sutton, Eng.). pp 433-441 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

Considerations of the biochemical and physiological characteristics of the pancreas suggest that amino-acids or amino-acid analogues should offer great potential as radiopharmaceuticals for pancreatic visualization. Selenomethionine-^{75}Se is commonly used, but this compound has several disadvantages including high liver uptake and a long effective half-life. Suitable amino-acids labelled with short-lived radionuclides would offer many advantages. Studies in rats with ^{18}F-labelled p-fluorophenylalanine, 3-fluorotyrosine and 5- and 6-fluorotryptophan and with ^{14}C-labelled phenylalanine, tyrosine and tryptophan are described. A clinical trial of p-fluorophenylalanine labelled with ^{18}F has been carried out. The results of scanning in four subjects are discussed together with evidence, obtained by the analysis of blood and urine over a period of 24 h, for the metabolic fate of the amino-acid analogue. A single patient was studied with 6-fluorotryptophan-^{18}F. The human studies suggest that defluorination occurs in man and the uptake of activity into the pancreas is not as great as might be expected from investigations using rats. The present status of this research is reviewed and the direction of future work indicated. (auth)

27155 TESTING OF PANCREAS SCANNING AGENTS BY AN INTUBATION PROCEDURE. Tothill, P.; Heading, R. C.; Shearman, D. J. C. (Royal Infirmary, Edinburgh). pp 443-449 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 1); CONF-730309-P1.

Animal experiments suggest that some other amino-acids than methionine should have a higher uptake in the pancreas, and efforts are being made to develop fluorinated analogues labelled with ^{18}F, or rapid syntheses to incorporate ^{11}C. Our studies aim to provide data on humans without the need to develop new labelling procedures. The basis is the measurement of activity in duodenal aspirates after the intravenous injection of readily available beta-emitting test agents during a standard pancreatic function test. The agent to be examined was compared with ^{75}Se-selenomethionine by simultaneous administration and differential counting. Samples were obtained from a duodenal tube at intervals during secretin stimulation. The concentration of ^{14}C-L-phenylalanine was about twice that of ^{75}Se-L-selenomethionine one hour after the start of stimulation in three patients, suggesting that the differences of pancreatic uptake observed in animals are maintained in humans. The final concentration of DL-p-fluorophenylalanine-3-^{14}C was equal to or less than that of ^{75}Se-L-selenomethionine in three other patients. Part of this difference is certainly due to the use of a DL racemate, but an effect of fluorination cannot be ruled out. (auth)

27156 PANEL DISCUSSION ON REGULATORY AND PHARMACEUTICAL RESPONSIBILITIES FOR RADIOPHARMACEUTICALS. pp 3-33 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

This panel concluded that a code for the preparation of radiopharmaceuticals should be established in each country similar to that of other pharmaceutical materials. It is pointed out that the International Pharmacopoeia represents a collection of recommended specifications which are not intended to have legal status in any country, but to serve as references so that national specifications can be established on a similar basis in any country. It is emphasized that radiopharmaceuticals are unlike other pharmaceuticals due to their radioactivity, and the philosophy of radiation protection requires that consideration be given to the balancing of the risk with the diagnostic benefit derived from their use. (CH)

27157 LONG-TERM RETENTION AND BIOLOGIC FATE OF ^{99m}Tc-IRON HYDROXIDE AGGREGATES. Davis, M. A. (Harvard Medical School, Boston). pp 43-63 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

A factor that has prevented ^{99m}Tc-iron hydroxide aggregates from achieving universal acceptance for lung scanning is the question of possible long-term pathologic damage from chronic residence of the metallic hydroxide aggregates in the pulmonary capillary bed. In an effort to substantiate the safety of this radiopharmaceutical, pharmacological and toxicological studies were made aimed at determining the biologic fate and mechanism of clearance of these particles. Results of experiments carried out in mice and dogs using double-labelled aggregates (^{99m}Tc and ^{59}Fe) and histologic sections of various organs stained for iron showed that there were three principal mechanisms by which the occluded capillaries could rid themselves of the iron hydroxide macroaggregates. The first and major mechanism of clearance is breakup of the rather soft, fluffy ferrous hydroxide aggregates into particles of micron and submicron size. These small colloid particles pass through the capillary bed of the lung and enter the general circulation where they are rapidly phagocytized by the R-E cells of the liver, spleen, and bone marrow. The second method of clearance involves dissolution of the ferrous hydroxide particles into ionic iron which is incorporated into the surrounding cells. Ferrous hydroxide has a finite solubility at pH values of 7.0 to 7.4; as the dissolved iron becomes incorporated into cells more of the precipitate dissolves because of the law of mass action. A third factor involved in the clearance of the macroaggregate from the blocked capillaries is phagocytosis of colloidal aggregates by alveolar macrophages and transport of these engulfed particles to the lymphatics. Determination of the actual residence time of these aggregates in the lung capillaries proved to be extremely difficult. Results from studies in patients showed the clearance to be related to: the chemical state of the iron

(Fe^{2+} or Fe^{3+}), the method of manufacture (temp + pH), the pathologic condition of the lungs, and the method in which the $T_{\frac{1}{2}}$ was determined (% activity remaining versus number of particles remaining). The clearance appeared to be independent of the number of particles injected in the range of 50,000 to 2×10^6. The initial 50% clearance time in normal subjects was shown to be 20 ± 2 h; however, the 50% clearance value in pathologic conditions was substantially greater. Estimates based on external counting of human subjects indicate that less than 3% of the injected number of particles remain in the capillaries six months after injection. The actual percentages could not be established from this series of experiments and may be significantly lower than the upper limit of 3%. Over 2000 lung scans were performed with this radiopharmaceutical without a single adverse reaction. (auth)

27158 ^{167}Tm-CITRATE FOR BONE IMAGING. Steinberg, M. (Odense Univ. Hospital, Denmark); Rasmussen, J. W.; Ennow, K.; Roy-Poulsen, N. O.; Voetmann, V.; Poulsen, B.; Andersen, M. L. pp 151-162 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

Thulium-167 was cyclotron-produced by bombardment of enriched ^{167}Er with deuterons (d,2n reaction). Formerly, ^{167}Tm had been produced by a ^{165}Ho(α,2n)^{167}Tm process, but this method of production has now been abandoned. After completion of the cyclotron run, the target material was dissolved in 4N HCl, and ^{167}Tm was separated from the erbium carrier by ion exchange chromatography. ^{167}Tm was then prepared for animal and patient studies of bone scintiscanning as a 0.067 M citrate solution, pH 5.5. A typical batch contained less than 10 μg of erbium carrier. Studies in patients indicated that mean whole-body retention of ^{167}Tm was 85%, 48 hr after intravenous injection of the citrated complex. Satisfactory bone imaging was performed in both laboratory animals and patients; examples of normal and abnormal scintigrams are presented. ^{167}Tm has a principal γ energy of 208 keV and a $T_{\frac{1}{2}}$ of 9.6 d. Based on a patient imaging dose of 500 μCi, the whole-body dose and skeletal dose were estimated to be 0.7 and 3.5 rads respectively. (auth)

27159 LABELLING AND TESTING OF UROKINASE AND STREPTOKINASE: NEW TRACERS FOR THE DETECTION OF THROMBOEMBOLI. Rhodes, B. A.; Bell, W. R.; Malmud, L. S.; Siegel, M. E.; Wagner, H. N. Jr. (Johns Hopkins Medical Institutions, Baltimore). pp 163-170 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

A specific scanning procedure that would permit detection and localization of blood clots by scanning could be widely applied as a diagnostic aid. Both urokinase and streptokinase are used clinically to promote lysis of thromboemboli. The proteins, diffused into thrombi, are cleared more rapidly from the blood stream than from the clots. This makes them potentially useful as scanning agents when tagged with appropriate tracers and ^{123}I, ^{131}I, and ^{99m}Tc have been used to label these proteins. The labelled proteins have been compared with the original proteins by measuring their enzymatic activity, and their immunoelectrophoretic and immunodiffusion patterns. Tissue distribution studies in mice and dogs show rapid blood clearance and urinary excretion of these tracers. Tests in dogs show localization of the tracers in pulmonary emboli. It is concluded that this new series of radiopharmaceuticals are potentially useful for blood clot scanning. (auth)

27160 SOME PHARMACOLOGICAL ASPECTS OF A NEW RADIOPHARMACEUTICAL, ^{111}In-BLEOMYCIN. Thakur, M. L.; Merrick, M. V.; Gunasekera, S. W. (Hammersmith Hospital, London). pp 183-193 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

The cytotoxic antibiotic Bleomycin has been labelled with a number of short-lived radionuclides of which ^{111}In is of particular interest. The thermal and chemical stability of the labelled substances is reported. Bleomycin labelled with ^{111}In, ^{99m}Tc, or ^{67}Ga was administered to rats with implanted tumors. It was found that the lesion-to-blood ratio is higher for the ^{111}In-labelled Bleomycin than for either of the others in every tumor studied. Excretion, blood clearance, and binding to blood proteins of radionuclide administered as labelled Bleomycin were investigated in man and the rat. Excretion is principally urinary but there was an inverse relationship between urinary and fecal elimination. Blood clearance was rapid. By 4 hr activity present in the blood was bound to the same protein fraction as occurs when the nuclide is administered in ionic form. (auth)

27161 RADIOPHARMACEUTICALS IN CLINICAL PHARMACOLOGY: ^{195m}Pt-cis-DIAMMINEDICHLOROPLATINUM(II). Wolf, W.; Manaka, R. C.; Ingalls, R. B. (Univ. of Southern California, Los Angeles). pp 205-221 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna, International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

One of the major problems in clinical pharmacology is the assessment of the optimal dose of a chemotherapeutic agent to be administered to a patient at each particular stage of his disease. It is the aim of these studies to evaluate whether a drug labeled with a γ emitter can be effectively used to determine rapidly and in vivo such parameters as target-to-non-target localization, drug distribution, and rate of compartmental transfer. cis-Diamminedichloroplatinum (NSC-119875) was labeled with ^{195m}Pt, obtained by ^{194}Pt(n,γ)^{195m}Pt, to a specific activity of 30 to 300 μCi/mg. The ^{195m}Pt decays by isomeric transition during 4.1 days and emits at 99 keV (12%) and 129 keV (2.4%), as well as Pt x rays (mostly 77 keV). The labeled drug was intravenously administered to 100 to 300-g rats, both control and with Walker 256 carcinosarcoma, at 2 mg/kg, in aqueous solution, followed by external counting using an Anger camera with a computer and/or sacrificing the animal and counting the activity of the individual organs. The radiopharmacokinetics indicate two phases: a rapid one completed in approximately 3 hr and a much longer phase resulting in significant liver and kidney retention at 48 and 72 hr. Tissue distribution studies over 72 hr suggest the presence of a reservoir from which the radiolabeled platinum compound is released to tissues and organs in a second distribution phase. The most significant difference between tumor bearing and normal animals was 0.2155 ± 0.08, whereas that of control rats is 0.0295 ± 0.02. This large difference in the rate may be significant both in assessing chemotherapy and for the diagnosis of a neoplastic condition. (auth)

27162 MEDICAL AND BIOLOGICAL APPLICATIONS OF STABLE CARBON, NITROGEN, AND OXYGEN ISOTOPES. Tolbert, B. M. (Univ. of Colorado, Boulder); Matwiyoff, N. A. pp 241-253 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

The enriched stable isotopes of carbon, oxygen, and nitrogen, (hydrogen-1, deuterium, ^{12}C, ^{13}C, ^{14}N, ^{15}N, ^{16}O, ^{17}O, and ^{18}O) are promising tools both for clinical medicine, experimental biology, and the medical sciences. Interest in stable isotopes has increased because recent developments in nmr, infra-red, and mass spectrometry have greatly increased the sensitivity and versatility of assay procedures for these isotopes. The resulting possibilities for novel applications to problems in the biological sciences are many, and several examples are given. Stable isotopes are seen as complementing and extending radioisotope applications. In spite of the promise of the stable isotopes as tools of biology and medicine, use will probably increase at a gradual pace because of complexity of present instrumentation and the relatively high cost of carrying out stable isotope experiments. (auth)

27163 EVALUATION OF DIABETES BY OXIDATION OF ^{14}C- OR ^{13}C-LABELLED GLUCOSE TO CO_2 IN VIVO. Shreeve, W. E. (Brookhaven National Lab., Upton, NY); Wu, C. H.; Roginsky, M. S.; Ott, D. G.; Gregg, C. T.; Uphoff, G. R.; Shoop, J. D.; Eaton, R. P. pp 281-292 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

Obese white female patients (19) with mild glucose intolerance formed $^{14}CO_2$ from glucose-1-^{14}C (administered orally) at approximately 60% of the mean rate for paired normal subjects (10) during the first 2 hr of an oral cortisone-glucose tolerance test. There were significant correlations between the rate of $^{14}CO_2$ formation and the intravenous or oral glucose tolerance by analysis of blood glucose concentration. Similar differences and correlations have since been found in our laboratory with a larger number of subjects (male and female) given glucose-1-^{14}C orally with a standard (non-cortisone) glucose tolerance test. Obesity is associated with lower production of $^{14}CO_2$ even with relatively normal blood glucose concentrations. Isotopic glucose may be useful for diagnosis of diabetes in this kind of test, which can employ simple

breath collection and require no venipunctures. Non-radioactive ^{13}C-labelled glucose would be especially applicable for children, pregnant women, and screening of large populations. Glucose-1-^{13}C and glucose-U-^{13}C (uniformly labelled) have been prepared by former techniques but with unusually large-scale syntheses. Preliminary findings with glucose-U-^{13}C indicate that adequate sensitivity (by ordinary mass spectrometric analysis) is obtained by administration of glucose containing no more than twice the natural abundance of ^{13}C(2 instead of 1 atoms %). Patients with diabetic glucose tolerance curves show sub-normal rates of appearance of expired $^{13}CO_2$, although the extent of difference may be small. Patients with pronounced glucose intolerance (blood concentrations >300 mg % during test) excrete CO_2 formed from glucose-1-^{14}C or glucose-U-^{13}C at half to one-third of the normal rate during the period 1 to 2 hr after ingestion. The pattern of $^{13}CO_2$ excretion after glucose-U-^{13}C may be abnormal in diabetics, e.g. a later time of peak concentration of ^{13}C. Various possible methods for analysis of $^{13}CO_2$ in clinical breath samples are discussed. (auth)

27164 ARGONNE PROGRAM FOR CLINICAL APPLICATIONS OF STABLE ISOTOPES. A Collaborative Multi-Focal Development of Methods and Applications. Klein, P. D. (Argonne National Lab., IL); Hofmann, A. F.; Nyhan, W. L.; Rosenberg, I. H.; Watkins, J. B. pp 293-309 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

Stable isotopes offer the clinician the unique ability to trace metabolic pathways, to measure pool sizes and replacement rates of body metabolites, and to compare key metabolic conversion rates in normal and diseased states, all without subjecting the patient to the hazard of administered radioactive compounds. Because of their safety, stable isotope tracers offer the first real opportunity for clinical metabolic research and diagnosis in the pregnant woman, the new-born infant, the young child, and large population groups. Exploitation of this opportunity is being carried out in a collaborative program involving nine clinical centers and the Division of Biological and Medical Research at Argonne National Laboratory. A central facility for the synthesis of labeled compounds and for the development and use of instrumentation of the required versatility and sensitivity serves the needs of individual clinical groups in their establishment, validation and routine use of non-radioactive tracer methodology. The systemization of this exploitation will be illustrated in four examples: use of deuterium-labeled folic acid to measure folate absorption during pregnancy; use of deuterium-labeled cholic acid to measure bile acid kinetics and pool size in new-born infants; use of ^{13}C-labeled glycine to diagnose and differentiate inborn errors of amino-acid metabolism in young children; and use of deuterium-labeled chenodeoxycholic acid to monitor changes in bile acid pool size in patients receiving chenodeoxycholate therapy to bring about dissolution of gallstones. (auth)

27165 PANEL DISCUSSION ON FUTURE DIRECTIONS IN RADIOPHARMACEUTICALS. Scheer, K. E. (Deutsches Krebsforschungszentrum, Heidelberg). pp 313-316 of Radiopharmaceuticals and Labeled Compounds. Vol. II. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol. 2); CONF-730309-P2.

The following conclusions reflect the opinion of most of the participants in this discussion: a wider application of radiopharmaceuticals prepared with generator-produced radionuclides will depend on the development of reliable and economical kits; typical cyclotron-produced nuclides such as ^{18}F, ^{81}Rb, ^{15}O, ^{13}N, and ^{11}C, will have a growing importance in nuclear medicine with the increase in the number of cyclotrons; high-current, high-energy linear accelerators will influence the development of nuclear medicine by producing a few important radionuclides on a large scale and at low cost, and ^{123}I might be the first and most widely used of them; rapid stationary detector scintigraphic systems (scintillation cameras) are expected to replace moving detector scintillation systems (rectilinear scanners); the development of a high-speed resolution positron coincidence stationary detector scintigraphic system is highly desirable; further improvements in radioimmunoassay techniques and the development of radioactive-labelled antibodies for in vivo measurements are expected to play an increasing role in the early detection of malignant tumors; and the development of new radiopharmaceuticals on the basis of radionuclides and of detecting and measuring instruments already in use still holds promise in many fields, particularly for functional studies. (auth)

27166 WHOLE BODY COUNTING USING A TWIN-DETECTOR SCANNER. Budd, R. S. (Cancer Inst. Melbourne). Australas. Radiol.; 17: No. 4, 464-469(Dec 1973).

A technique of whole-body counting using a modified profile scanner is described for the measurement of iron absorption using ^{59}Fe. The results show that, in addition to its obvious advantages to the patient such as absence of fecal collection and minimal number of out-patient visits, whole-body counting is a simple and convenient technique and is of satisfactory accuracy. Iron absorption was studied in 12 male and 6 female subjects. The average percent retention for 10 normal subjects was from 8.4 to 22.5. The other eight patients studied had all previously undergone splenectomy as part of treatment for hereditary spherocytosis and their average percent retention was found to be 28.3 ± 18.7 (I.S.D.) with a range of 8.7 to 60.0. (auth)

27167 RADIOACTIVE TIN COMPOUND AS A NEW BONE SCANNING AGENT. Ando, A. (Kanazawa Univ., Japan); Hisada, K.; Matsudaira, M.; Ando, I. Radioisotopes (Tokyo); 22: No. 6, 297-302(Jan 1973). (In Japanese).

There is no report of using of radioactive tin for skeletal imaging. As previously reported, ^{113}Sn-citrate had very strong affinity for bone. Among the isotopes of tin, ^{117m}Sn has ideal physical characteristics for gamma camera systems. In order to evaluate possibilities of bone scanning with ^{117m}Sn, the present study was performed. Before embarking on the production of ^{117m}Sn, we decided to use ^{113}Sn in a series of experiments with rats. Localization of bone-seeking compounds in the skeleton differs considerably with the age of animals. Consequently, ^{85}Sr (as chloride) was used with ^{113}Sn-citrate in these experiments as a biological standard. ^{113}Sn-citrate and ^{85}Sr-chloride were injected intravenously to each animal, respectively. The animals were sacrificed serially from 1 to 24 hrs after injection. The soft tissue (except kidney) and blood concentrations of ^{113}Sn-citrate were less than those for ^{85}Sr at 1 hr and 3 hrs after injection, and were similar to those for ^{85}Sr at 24 hrs after injection, whereas the skeletal concentration of ^{113}Sn-citrate were slightly less than those for ^{85}Sr from 1 to 24 hrs after injection. The cumulative urinary excretion of ^{113}Sn at 3 hrs was approximately 54% (compared with 3% of ^{85}Sr), the residue, which was almost accumulated in bone, was excreted very slowly in biological half-life of 31.5 days. ^{113}Sn-citrate had excellent biological property for bone scanning agent, compared with ^{85}Sr. It is the major advantage that ^{113}Sn-citrate was excreted in urine and was hardly excreted in the gastrointestinal tract. (auth)

27168 ^{87m}Sr BONE SCINTIGRAPHY BY MINI-SCANNING METHOD. Watanabe, K.; Kawahira, K.; Kamoi, I. (Kyushu Univ., Fukuoka). Radioisotopes (Tokyo); 22: No. 7, 366-372(Jul 1973). (In Japanese).

Strontium-87m bone scintigraphy was performed in 22 cases of bone metastasis or suspected bone metastasis of malignant tumors and 1 case of necrosis of the head of the femur. This mini-scanning method showed abnormalities in four out of six cases in which bone metastasis was demonstrated by roentgenography. No abnormalities were observed in 15 out of 16 cases in which no abnormalities were seen by roentgenography. Abnormalities were observed in the lesion in one case of necrosis of the head of the femur as indicated by roentgenography. The mini-scanning method with ^{87m}Sr failed to demonstrate any abnormalities in 3 out of 23 cases. Causes for these failures were examined, discussing problems of the mini-scanning method and of the use of ^{87m}Sr as radioisotope for scintigraphy. (auth)

27169 STUDY OF REGIONAL PULMONARY FUNCTIONS IN NORMAL AND DISEASED SUBJECTS BY ^{133}Xe SCANNING METHOD. Takahashi, K. (Tohoku Univ., Sendai). Tohoku Igaku Zasshi; 85: No. 6, 296-314(Nov 1973). (In Japanese).

Pulmonary mechanics and regional pulmonary functions in normal and diseased subjects were analyzed by the newly provided ^{133}Xe scanning device. In upright normal men, lung volume, ventilation, and perfusion were regionally affected by gravity as already reported by others. The perfusion/volume ratios were increased from the top to the base of the lung, however the ventilation/volume ratios were kept constant through the lung. Intrathoracic pressure was related with diaphragmatic movement such that it often indicated very positive in the dependent regions at low lung volume in cases of large diaphragmatic movement. It was concluded that diaphragmatic movement was a very important factor determining the distribution of ventilation. The presented ^{133}Xe scanning device was suggested quite useful in detection of regional distribution in function such as delays of gas clearance, residual volume/total lung capacity in emphysematous patients. Furthermore it was shown that the present scanning method was also excellent in analysis of regional perfusion which was not shown by ^{131}I-MAA scanning method in hilar lung cancer. (auth)

27170 VASCULAR CONTENT OF HEPATIC LESIONS BY DUAL ISOTOPE SCANNING. Sephton, R. G. (Cancer Inst., Melbourne); Martin, J. J.; Andrews, J. T.; Steven, L. W.; Arkles, L. B. Australas. Radiol.; 17: No. 4, 406-410(Dec 1973).

A description is given of the parallel use of a vascular or blood pool radioactive tracer to assess the vascular content of a lesion relative to surrounding the healthy liver by comparing its amplitude or contrast on both reticuloendothelial and vascular scans. The scan discrimination between relatively vascular lesions and avascular processes such as cysts and abscesses is discussed. The radioactive tracers used in the study were ^{99m}Tc sulphur colloid and ^{113m}In. (auth)

27171 INITIAL SLOPE OF XENON-133 WASH-OUT CURVE FROM THE LIVER COMPARED TO RECORDED TOTAL OUTFLOW. Darle, N.; Kock, N. G.; Lewis, D. H. (Univ. of Goteborg). Eur. Surg. Res.; 4: 166-174(1972).

A comparison was made between the blood flow calculated from the initial slope of the ^{133}Xe elimination curve registered by scintillation scanning over the liver of fasting cats after intraportal injection of the tracer and the simultaneously recorded total outflow from the liver. This was made possible by diversion of the blood from the hepatic veins to a flow recorder outside the animal. The results indicate that in the same animal there is a fairly constant relationship between the flow values even under different rates of flow. Between different cats this relationship varies. Flow values calculated from the initial slope of the ^{133}Xe elimination curve are valid as far as relative changes in total liver blood flow is concerned. (auth)

27172 EVALUATION OF USEFULNESS OF ISOTOPE RENOGRAPHY WITH ^{131}I-HIPPURATE. Baranowska, B. Pol. Tyg. Lek.; 27: No. 51, 2020-2023(1972). (In Polish).

Radioisotope renography with ^{131}I-hippurate was done in 170 cases: in 76 cases of arterial hypertension of various etiology, in 70 cases of urinary tract occlusion, and in 24 other diseases the following parameters of the renographic curve were established: height of the vascular segment, T max and T ½. In arterial hypertension due to renal artery stenosis a significant asymmetry of the curves was observed, with lowering of the vascular segment, prolongation of T max and T ½. In glomerulonephritis, cystic renal degeneration, and renal amylodosis during renal failure the renographic curves were symmetrically flattened. In acute ureteral urolithiasis the curve failed to demonstrate the excretion phase on the side of occlusion. In hydronephrosis the curve was markedly flattened, and in patients with pyonephrosis demonstrated during surgery the renographic curve showed findings corresponding to that of inactive kidney with absent phases of secretion and excretion. Radioisotope renography is a good screening test in arterial hypertension permitting a rapid detection of occlusion of the urinary tract, determining the degree of occlusion and the activity of kidneys. In renal failure it can show quickly whether it is due to disturbances in urine outflow. (auth)

27173 EVALUATION OF SECTION THICKNESS OF SKIN IN DETERMINING THE EPIDERMAL LABELING INDEX WITH TRITIATED THYMIDINE. Taguchi, Y. H.; Tabachnick, J. (Albert Einstein Medical Center, Philadelphia). Arch. Dermatol. Forsch.; 247: 207-210(1973).

Epidermal basal cells in the albino guinea pig were pulse labeled with tritiated thymidine (^{3}H-TdR) by intraperitoneal or intradermal injection, and the fraction of labeled cells [labeling index (LI)] was compared in 4μ versus 6μ sections. The LI scored in 6μ sections was about 10% lower than that in 4μ sections. For our purpose, it is unnecessary to submit to the technical difficulties of routinely cutting sections of skin thinner than 5 to 6μ for autoradiography of ^{3}H-TdR, since the increase in scoring efficiency is relatively small (10 to 20%). (auth)

27174 QUANTITATIVE MEASUREMENTS OF LUNG FUNCTION IN CHILDREN BY MEANS OF COMPTON BACKSCATTER. Schuster, W.; Stephan, U. (Erlangen-Nuernberg Univ., Erlangen, Ger.). pp 255-260 of Malignant Diseases and Radiology Medicine. Vol. 14. Vienna; Wiener Medizinisch Akademie (1971).

Compton scatter of high-energy gamma rays was successfully used to determine the absolute lung density and its variation in vivo. For the first time, this permits measurement of the lung function without the active cooperation of the patient. Some clinical examples (cystic fibrosis, pneumonia) taken from a total of 150 patients are described. The quantitative evaluation makes it possible to attain objectivity and carry out follow-up checks during therapy. (auth)

27175 DETECTION OF TWO-DIMENSIONAL RESPIRATORY MOVEMENT AND ITS CORRECTION ON THE SCINTILLATION CAMERA IMAGES. Matsumoto, T.; Fukuda, N.; Yabumoto, E.; Fukuhisa, K. (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 8, 671-682(Aug 1973). (In Japanese).

Processing of images obtained with a scintillation camera by the on-line computer was described for correction of image distortion due to the respiratory movement. Serial image data sampling and calculation of the center of gravity for each frame allowed the detection of two-dimensional respiratory movement and correction of respiratory movement by superimposition of the frames according to each center of gravity. Experiments with liver phantom and respiration simulator showed that the optimum sampling interval was one-fourth of the respiration cycle in conjunction with statistical fluctuation in calculation of the center of gravity and precise decision of magnitude of respiratory movement. Results of the calculation well agreed with the actual movement of the phantom. The superimposed images in phantom and patients also well agreed with the static images without respiratory movement. The serial calculations of center of gravity were applied to the vertically divided sub-images and possibility of correction was suggested in such a case that the magnitude of movement was not even throughout the organ. In the liver image, the horizontal movement failed to be differentiated from the statistical fluctuation. The correction was not only useful for increased detectability of small lesion but also essential for computer image restoration as a pre-processing. (auth)

27176 HEMODYNAMIC STUDIES ON TUMOR. Harada, Y. (Kobe Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 9, 740-755(Sep 1973). (In Japanese).

Present investigations dealt with experimental and clinical studies on hemodynamics of tumors during their developmental process or under the influence of irradiation. Most of the studies were made on the estimation of regional blood flow by the use of ^{133}Xe-local clearance technique. Yoshida sarcoma was used for the experimental studies. The characteristics of the tumor were discussed, comparing with those of the experimental inflammatory lesion (tuberculosis). In addition, the effect of irradiation on the tumor was analyzed in relation to the regional blood flow after irradiation of cobalt-60 using the formula based on Fick's principle. For clinical studies, patients with tongue cancer were employed to evaluate the blood flow using the height-over-area method for calculation. Radiation dose (electron and radium) for the complete disappearance of tongue cancer was estimated and compared with the regional blood flow calculated before irradiation. The blood flow decreased as Yoshida sarcoma developed with its central necrosis formation. At the peripheral part of the tumor, blood flow was usually increased, leading to a medullary growth. The blood flow essential for the development of the tumor was calculated to be about 50 ml/100 g/min. The inflammatory lesion showed a constant blood flow, which was not influenced by the degree of the lesion. The phenomenon of temporary increased blood flow was observed in tumors that received 1000 rads of irradiation. The regional blood flow of the tumor measured before irradiation showed a close correlation with the radiation dose for the disappearance of tongue cancer. The high therapeutic ratio of tongue cancer could be explained by the higher blood flow in the tumor than that in the surrounding normal tissue. The regional blood flow in tongue cancer had a close correlation with the radiation dose for tumor disappearance. The blood flow of 1 ml/100 g/min was estimated to be equivalent to the radiation dose of about 30 rads. (auth)

27177 COMPUTER SCINTIGRAPHY FOR DETECTING LIVER TUMOR USING A SCINTILLATION CAMERA AND ^{67}Ga-CITRATE. Yumoto, Y.; Tanaka, Y.; Nanba, T.; Kosaka, K. (Okayama Univ., Japan). Kaku Igaku; 10: No. 5, 467-477(Oct 1973). (In Japanese).

Nineteen patients bearing focal defects on the liver scans with radiocolloid were studied with ^{67}Ga-citrate. Images of the liver were obtained 48 to 72 hrs after injection of 1 to 2 mCi of ^{67}Ga-citrate intravenously. A scintillation camera (Pho/Gamma III) was used, and all images were recorded on Polaroid films. In addition to the conventional Polaroid photographs, the data were also fed into a computer system and stored in the memory cores. Definite tumor accumulation of the ^{67}Ga-citrate was noted in 14 of 15 patients with malignant tumors—4 of 5 with hepatocellular carcinomas, 3 of 9 with metastatic liver tumors. The tracers were poorly accumulated by a hepatocellular carcinoma, a cholangiohepatic carcinoma, and five metastatic liver tumors. The gallium study was found to be helpful in the differential diagnosis of focal liver abnormalities detected by ^{99m}Tc-sulfur colloid scans. A focal liver abnormality that accumulated more gallium than surrounding normal tissue was more likely to be malignant tumor than benign condition such as cirrhosis. The combination of ^{67}Ga-citrate and ^{99m}Tc-sulfur colloid was found to be helpful to distinguish the patients with hepatic malignancies to those with cirrhotic scarring. After the ^{67}Ga study was performed with leaving the patient in the same position under the detector, we

gave 1 mCi of ^{99m}Tc-sulfur colloid intravenously and again obtain a san image of the liver. All data were stored in the tape recorder to provide it for computer scintigraphy and for subtraction scintigram. Gallium-67 citrate distributes also within the normal liver tissue. This made it difficult to deliniate the tumor image of the liver. The computer subtraction scintigraphy with the use of ^{67}Ga-citrate and ^{198}Au-colloid or ^{99m}Tc-sulfur-colloid allow to overcome the disadvantage of ^{67}Ga-citrate. (auth)

27178 NUCLEAR MEDICINE AND RADIOCHEMISTRY. Goette, H.; Kloss, G. (Farbwerke Hoechst AG, Frankfurt am Main). Angew. Chem.; 85: No. 18, 793-802(1973). (In German).

Nuclear-medical diagnostic techniques are nowadays widely applied. The localization of diagnosis of the thyroid gland, the kidneys and the spleen as well as functional tests of the thyroid and the liver are mentioned as examples. Organ-specific vehicle substances labeled with suitable radionuclides have to be available for performing tests of such kind. As to in-vivo controls, the radiation burden should be as low as possible for the patient but on the other hand, the radiation intensity must be sufficiently high for the measurement to be performed. The usefulness of labeled compounds in diagnosis is by far greater than in therapy. (GE)

27179 PREPARATION AND ASSESSMENT OF RADIOACTIVE TRACERS. Hunter, W. M. (Medical Research Council, Edinburgh). Brit. Med. Bull.; 30: No. 1, 18-23(Jan 1974).

An introduction to preparation of tracers for radioimmunoassay and saturation analysis is presented, and techniques are reviewed in outline under the following headings: properties required in the labeled antigen; preparation of labeled antigen; assessment of labele antigen preparations; causes of iodination damage; alternative methods to the chloramine-T procedure i.e., enzymatic iodination of tyrosyl groups, gaseous diffusion of oxidant, conjugation labeling; limits of high specific activities, with particular reference to ^{125}I; and iodinated tracers for hapten-specific radioimmunoassay systems. (UK)

27180 DEXTRAN–CHARCOAL AND DIOXANE PHASE SEPARATION METHODS IN THE RADIOIMMUNOASSAY FOR PARATHYROID HORMONE AND CALCITONIN. Habener, J. F.; Mayer, G. P.; Powell, D.; Murray, T. M.; Singer, F. R.; Potts, J. T. Jr. (Massachusetts General Hospital, Boston). Clin. Chim. Acta; 45: No. 3, 225-233(18 May 1973).

Dioxane precipitation and dextran-charcoal adsorption were used to separate free from bound ^{125}I-labelled hormone in the radioimmunoassays of calcitonin and parathyroid hormone. Changes in the fraction of bound radioactivity, independent of hormone concentrations, were seen with changes in temperature, plasma concentration, time of standing, and amount of dioxane or dextran-charcoal added. Characterization of these variables affecting bound radioactivity, and careful standardization of the conditions of phase separation, indicate that dioxane precipitation is a satisfactory method for the calcitonin immunoassay while dextran-charcoal adsorption provides the most reliable results in the parathyroid hormone immunoassay. (INIS)

27181 RADIONUCLIDES IN PEDIATRIC NEPHROLOGY. Edelmann, C. M. (Albert Einstein Coll., Bronx, NY). pp 249-253 of Malignant Diseases and Radiology Medicine. Vol. 14. Vienna; Wiener Medizinisch Akademie (1971).

Plasma disappearance curves of appropriate radionuclides, injected intravenously, as a single bolus, provide accurate estimates of glomerular filtration rate and renal plasma flow. Vesicular-ureteral reflux can be demonstrated following instillation into the bladder of technetium-99-pertechnetate, distention of the bladder with saline, and monitoring over the bladder, ureters, and kidneys with a gamma camera. This technique may detect reflux that is missed with conventional cystourethrography. The low radiation dosimetry makes it ideal for children requiring long-term follow up and repeated studies. (INIS)

27182 RAPID SOLID-PHASE RADIOIMMUNOASSAY FOR STAPHYLOCOCCAL ENTEROTOXIN A. Collins, W. S.; Johnson, A. D.; Metzger, J. F.; Bennett, R. W. (Army Medical Research Inst. of Infectious Diseases, Frederick, MD). Appl. Microbiol.; 25: No. 5, 774-777(May 1973).

A rapid solid-phase radioimmunoassay for staphyloccal enterotoxin A is described. The assay procedure requires 3 to 4 h for completion by using a competitive inhibition system in which the antibody is attached to bromacetyl cellulose particles. It is accurate to a level of 0.01 μg of enterotoxin A/ml in a variety of media such as ham, milk products, crab meat, custard, etc. No significant interference was found with any media or food product tested. (auth)

27183 EVALUATION OF RADIOMETRIC SYSTEM FOR DETECTING BACTEREMIA. Renner, E. D.; Gatheridge, L. A.; Washington, J. A. II. (Mayo Clinic, Rochester, MN). Appl. Microbiol.; 26: No. 3, 368-372(Sep 1973).

An automated radiometric system (BACTEC, Johnston Laboratories) for detection of bacteremia was evaluated in parallel with a standard blood culture system in use in our laboratory. Of 1,445 blood cultures from 484 patients with possible bacteremia, 106 sets of cultures (excluding 39 presumed contaminated), representing 56 patients, were positive by both methods. The conventional system yielded 85 positive cultures from 48 patients, whereas the BACTEC system yielded 84 positive cultures from 43 patients. The BACTEC system failed to detect 22 cultures that were positive in the conventional system, and the conventional system failed to detect 21 cultures that were positive in the BACTEC system. The detection efficiency was generally equivalent in the two systems except for the lower detection rates of anaerobes and Enterobacter aerogenes by the BACTEC system and the lower detection rates of Torulopsis glabrata and, possibly, Pseudomonas sp. (group IVD) in the conventional system. The BACTEC system had a slight advantage over the conventional system in the time interval to detection of positivity. Approximately 20% of the positive cultures detected by the BACTEC system were detected on the first day of incubation compared with 7% by the conventional system. The recovery rates and detection times of anaerobes were less efficient by the BACTEC system than by the conventional system. It does not appear that the radiometric method has much advantage over available conventional methods. (auth)

27184 STAPHYLOCOCCAL ENTEROTOXINS A AND B: SOLID-PHASE RADIOIMMUNOASSAY IN FOOD. Johnson, H. M.; Bukovic, J. A.; Kauffmann, P. E. (Food and Drug Administration, Cincinnati). Appl. Microbiol.; 26: No. 3, 309-313(Sep 1973).

An immunoassay employing ^{125}I labeled enterotoxins A and B and polystyrene tubes coated with specific antibodies was used for detection and quantitation of enterotoxin in food. Ham salad, cheddar cheese, custard, condensed milk, and salami were studied. Enterotoxin was successfully determined in all the foods by simple extraction procedures. The assay was sensitive to 1 to 10 ng of toxin per g of food; nonspecific inhibitions were 15% or less. (auth)

27185 METHOD FOR RADIORESPIROMETRIC DETECTION OF BACTERIA IN PURE CULTURE AND IN BLOOD. Schrot, J. R.; Hess, W. C.; Levin, G. V. (Biospherics Inc., Rockville, MD). Appl. Microbiol.; 26: No. 6, 867-873(Dec 1973).

Methods are described for the detection of low numbers of bacteria by monitoring $^{14}CO_2$ evolved from ^{14}C-labeled substrates. Cell suspensions are filtered with membrane filters, and the filter is then moistened with 0.1 ml of labeled medium in a small, closed apparatus. Evolved $^{14}CO_2$ is collected with $Ba(OH)_2$-moistened filter pads and assayed with conventional radioactivity counting equipment. The kinetics of $^{14}CO_2$ evolution are shown for several species of bacteria. Fewer than 100 colony-forming units of most species tested were detected in 2 h or less. Bacteria were inoculated into blood and the mixture was treated to lyse the blood cells. The suspension was filtered and the filter was placed in a small volume of labeled medium. The evolved $^{14}CO_2$ was trapped and counted. A key development in the methodology was finding that an aqueous solution of Rhozyme and Triton X-100 produced lysis of blood but was not detrimental to bacteria. (auth)

MATERIALS

27186 (AD-766233-1) SOLID STATE RESEARCH, 1973:2. Quarterly Technical Summary Report, 1 February–30 April 1973. McWhorter, A. L. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 15 May 1973. Contract F19628-73-C-0002. 68p. (ESD-TR-73-100). NTIS $3.50.

The report covers in detail the solid state research work of the Solid State Division at Lincoln Laboratory for the period 1 February through 30 April 1973. The topics covered are solid state device research, quantum electronics, materials research, physics of solids, and microelectronics. The microsound work is sponsored by ABMDA and is reported under that program. (GRA)

27187 (DC-59-10-166) GE–ANPD SHIELD MATERIALS, A STATUS REPORT. Baxter, W. G.; Bauer, P.; Kilb, E. P.; Welch, F. H. (General Electric Co., Cincinnati, Ohio (USA). Aircraft Nuclear Propulsion Dept.). 15 Oct 1959. Contract AT(11-1)-171. 78p. Dep. NTIS $6.00.

Declassified 13 Sep 1973.

A review of the shield materials which have been developed for the XMA-1A power plant (two turbojet engines coupled to a single reactor–shield configuration) is presented. Beryllium-boron; tungsten–copper–nickel alloys with boron additions and oxidation protective coatings; Type 304 stainless steel with 0.2% ^{10}B and 1% natural B; LiH shapes; beryllium oxide–boron; and BeO–Zr boride are discussed with regard to fabrication, physical property measurements, and component testing. (33 fig, 15 tables) (auth)

27188 (GEMP-475-B) HIGH-TEMPERATURE MATERIALS PROGRAM. Part B. Sixth Annual Report. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 28 Feb 1967. Contract AT(40-1)-2847. 197p. Dep. NTIS $13.00.

Declassified 21 Sep 1973.

This report covers six programs: (1) studies of substoichiometric urania and urania solid solutions above 1700°C and their compatibility with refractory metals; (2) refractory-metal fuel element development for operation in non-oxidizing atmospheres; (3) specific materials property data for various refractory metals and alloys and refractory-metal–UO_2 composites; (4) fission product transport processes in refractory-metal fuel systems at temperatures exceeding 1400°C; (5) development of long-life, fueled and unfueled, clad metal hydrides, control elements, and shield materials; and (6) the effect of high fuel burnup on BeO-stabilized fuel materials. (DLC)

27189 (TIM-870) STATUS OF MATERIALS DEVELOPMENT IN SUPPORT OF PWAR-20. DeCrescente, M. A.; Kelly, K. J.; Treciokas, P. V. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1 Dec 1964. Contract AT(30-1)-2789. 24p. Dep. NTIS $4.25.

Declassified 31 Aug 1973.

The PWAR-20 reactor and shield are being developed for the SNAP-50/SPUR power plant (300-kW(e), 10,000 h). Clad UC and UN were irradiated; swelling and gas release were measured. Nb–1 Zr, D–43, and T–111 were also evaluated. (DLC)

Ceramics and Cermets

Refer also to abstracts 26630, 26633, 26634, 27280, 27309, 27323, 28661, 28670, 28918, and 28928.

27190 (AD-763480) LOW-TEMPERATURE SOLUBILITY OF HYDROGEN IN NIOBIUM. Holmquist, G. R.; Birnbaum, H. K. (Illinois Univ., Urbana (USA)). Jul 1973. 31p. NTIS $3.00.

The precipitation of hydrogen from solid solution to form a hydride was studied in the Nb–H and Nb–D systems at temperatures between 77 and 300°K. A large amount of undercooling was observed during cooling, the extent of which decreased after thermal cycling. On heating, a large thermal hysteresis was observed before resolution of the hydrides occurred. These results were interpreted in terms of a precipitation model which requires a large amount of plastic accommodation to occur during precipitation. The effects of N additions and cold working were studied and shown to be consistent with this model. (auth)

27191 (AD-763656) EFFECT OF TEMPERATURE AND STRAIN RATE ON THE TENSILE PROPERTIES OF ALUMINUM–BORON, EPOXY–BORON, AND EPOXY–GRAPHITE COMPOSITES. Final Report. Meyn, D. A.; Shahinian, P. (Naval Research Lab., Washington, D.C. (USA)). Jun 1973. 36p. (NRL-MR-2609). NTIS $3.75.

The effects of strain rates from 0.00008 to 0.4/sec on tensile strengths and moduli of 6061 aluminum–46.5 vol % boron at temperatures up to 1000°F, of unidirectional and cross-ply epoxy–50 vol % boron composites at temperatures up to 500°F and of cross-ply epoxy–60 vol % graphite composites at temperatures up to 250°F were measured. Longitudinal properties were reduced moderately at high temperatures and were only slightly higher at high strain rates than at low strain rates. Transverse properties decreased rapidly with temperature and were either unaffected by high strain rates, particularly at low temperatures, or were substantially increased, especially at high temperatures, in both aluminum- and epoxy-based systems. (auth)

27192 (AD-764355) ELASTIC PROPERTIES OF BORON SUBOXIDE AND THE DIAMETRICAL COMPRESSION OF BRITTLE SPHERES. Petrak, D. R.; Ruh, R.; Shook, W. B. (Air Force Materials Lab., Wright-Patterson AFB, Ohio (USA)). Jun 1973. 99p. (AFML-TR-73-84). NTIS $3.75.

The room temperature elastic moduli of hot pressed boron suboxide were determined in the 0 to 16% porosity range using the resonant sphere technique. Results revealed that Poisson's ratio was constant in this range and that Young's and shear moduli followed Hasselman's semi-empirical relation with $E_o = 68.5 \times 10^6 \psi$ and A = 5.1. High speed photographs of diametrically compressed glass spheres indicate that fracture initiates near the center of the sphere. Also a stress analysis of such a sphere shows that the maximum tensile stress occurs near the center of the sphere. Therefore a new test for the tensile strength of brittle materials is suggested which is not influenced by surface defects. The tensile strength of boron suboxide was determined using the diametrical compression test and values approximately 25% lower than four point bend tests were obtained. (GRA)

27193 (AD-768795-7-GA) ELECTRONIC AND RADIATION DAMAGE PROPERTIES OF RUTILE. Progress Report, 1 August 1972–15 August 1973. DeFord, J. W.; Johnson, O. W.; Rosenberger, F. (Utah Univ., Salt Lake City (USA). Dept. of Physics). 15 Aug 1973. 26p. NTIS $3.00.

The coupled differential equations (which are nonlinear) for the diffusion of charged ions in a semiconductor or insulator such as TiO_2, cannot be solved analytically, except for certain limiting cases which are not particularly helpful, and hence must be treated numerically. Most of the effort was devoted to developing a computer program to handle this problem. Other areas of research include ESR measurements, and associated with lattice defects or impurities always present in the lattice, and crystal growth and characterization. (GRA)

27194 (BNL-tr-562) STUDY OF NUCLEAR MAGNETISM IN VAN VLECK PARAMAGNETS USING NEUTRON SCATTERING. Khennig, K.; Sharapov, E. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. Translation by S. J. Amoretty of JINR-P14-7026. 13p. Dep. NTIS $3.00.

The possible study of nuclear magnetism in Van Vleck paramagnetics using the pulse reactor at superlow temperature is discussed. The neutron-diffraction method is shown to be promising due to the comparatively high intensity of peaks connected with the ordering of the nuclei and due to possible separation of nuclear and electron magnetism effects through the scattering angular dependence. A search experiment is suggested: direct observation of nuclear antiferromagnetism in intermetallic compound $PrCu_2$ by neutron diffraction at temperatures below 50 m °K. (auth)

27195 (CEA-CONF-2514) SOME RESULTS ON THE DEPOSITS FORMED DURING USE ON FUEL ELEMENT CASINGS. Delafosse, J.; Mansard, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1973. 30p. (In French). (CONF-731063-2). Dep. NTIS (U. S. Sales Only) $3.50.

From meeting of specialists on the safety of fuel elements for water reactors; Saclay, France (22 Oct 1973).

Fuel elements irradiated in pressurized water reactors are covered with more or less adherent deposits. In some cases these deposits can interfere with the fuel–water thermal exchanges. The perforation of the casings which can result from the presence of adherent deposits in zones with high thermal flux and low flow was examined. The analyses made it possible to establish the nature and the origin of the deposits, although the parameters affecting their formation must be made more precise. All the results show that the deposits consist essentially of metallic oxides from the primary circuit of the re-

actor. Among these oxides, spinels (mixed oxides of iron and nickel) predominate. Their magnetic nature makes it possible to predict means of eliminating them. It is stressed that very thick deposits can originate from very pure water: 15 to 30 ppB of iron. (tr-auth)

27196 (CEA-CONF-2532) PRESENCE OF TRITIUM IN ZIRCALOY CASINGS OF PRESSURIZED WATER REACTORS. Experimental Results. Bazin, J.; Jouan, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1973. 29p. (In French). (CONF-731063-1). Dep. NTIS (U. S. Sales Only) $3.50.

From meeting of specialists on the safety of fuel elements for water reactors; Saclay, France (22 Oct 1973).

The tritium formed by ternary fission at the interior of fuel elements can be distributed in the case of Zircaloy-cased elements among the fuel, the gases released, and the casing. Experimental pins were used to determine the tritium concentrations in each of these. The elements analyzed were irradiated up to a maximum burn-up between 20,000 and 23,000 MWd/t U at a maximum linear power of 515 W/cm. In these power conditions the tritium balance is established in the following manner for a tight pin. In the fuel the mean concentration equal to approximately 3×10^{-3} μg/g UO_2 corresponds to about 19% of the tritium formed. In the casing the mean concentration is about 7×10^{-2} μg/g of Zircaloy outside the plug, which corresponds to about 81% of the tritium formed. The concentration in the plugs is of the order of several thousandths of that in the casing. (tr-auth)

27197 (CEA-N-1637) STUDY OF THE EFFECT OF IRRADIATIONS ON AMORPHOUS ZIRCONIA. Soullard, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Oct 1973. 53p. (In French). Dep. NTIS (U. S. Sales Only) $4.75.

Thesis. Submitted to Poitiers Univ. (France).

Amorphous zirconia was irradiated in order to independently study the thermal effects due to particles slowing-down as a result of electron excitation (fission fragments) and those due to particles slowing-down as a result of atomic collisions (1 MeV Kr^+ ions). The crystallization of amorphous zirconia was studied by heating it in a furnace. The crystallization takes the form of a nucleation and growth mechanism. The crystallization activation energy is about 2 eV/mole. A comparison was then made between thermal effects obtained in a furnace and radiation induced effects. Amorphous zirconia irradiated with high doses of fission fragments crystallizes. It is shown that this crystallization is due to γ heating. Tracks of noncrystalline structure were observed in amorphous zirconia irradiated with small doses. The threshold stopping power for which a particle leaves a trace in this material was determined. After irradiation with low energy ions, amorphous zirconia exhibits zones which are more transparent to electrons than the amorphous matrix. It is believed that these zones are created by displacement cascades and that the internal atomic order of these zones is greater than that of the amorphous matrix. The energy necessary for a primary particle to induce such zones by a displacement cascade was determined. A calculation is then presented enabling the energy given up to the lattice, the range, and the number of primary atoms set into motion by a particle slowing down in a compound substance to be determined. The results of this calculation are used to explain some of the experimental results obtained for zirconia. (FR)

27198 (FRNC-TH-422) STUDY BY ESR AND ENDOR OF POINT DEFECTS IN BeO. Maffeo, B. (Grenoble-1 Univ., 38 (France)). 1973. 265p. (In French). Dep. NTIS (U.S. Sales Only) $15.25.

Thesis.

Paramagnetic point defects created in BeO by irradiation with fast particles (electrons and neutrons) were studied. The two charge states of beryllium vacancies were identified. This defect and its antimorph, the F^+ center, constitute the only intrinsic defects identifiable in metallic oxides. A paramagnetic center obtained by the high-temperature annealing of an irradiated crystal was studied. A simple theoretical calculation was made of the g tensor for which the results confirm the validity of the model proposed (two beryllium vacancies, one of which is situated on the c axis of the crystal and is a close neighbor to an O^- ion). In addition, an octahedrally positioned interstitial impurity was identified for BeO. (FR)

27199 (GA-5016(Pt.2)) ADVANCED, GRAPHITE-MATRIX, DISPERSION TYPE FUEL SYSTEMS. Annual Report, April 1, 1963–March 31, 1964. Bokros, J. C.; Goeddel, W. V.; Sandefur, N. L.; White, J. L. (General Dynamics Corp., San Diego, Calif. (USA). General Atomic Div.). 1964. Contract AT(04-3)-167. 79p. Dep. NTIS $6.00.

Declassified 4 Sep 1973.

An exploratory study of the kinetics of uranium migration into pyrolytic-carbon coatings on carbide fuel particles has been completed. Curves of migration distance versus the square root of time are not linear but show a high migration rate (initial stage) followed by a slower rate (second stage). The mechanism of uranium migration into pyrolytic-carbon coatings on UC_2 fuel particles has been investigated by means of x-ray diffraction techniques, metallography, microradiography, electron-probe analyses, and electron microscopy. It was found that initially the coating absorbs a large amount of uranium from the UC_2 fuel particle; the region of the coating that contains uranium in solution recrystallizes; and because of the apparent lower solubility of uranium in the primary graphite crystals than in the random layer lattice of the original coating, UC_2 precipitates in the recrystallized region. As this process takes place, the migration rate decreases. The results also suggest that the migration process is sensitive to the structure of the pyrolytic carbon. Studies of the application of hot-working processes to the fabrication of graphite-matrix fuel bodies have shown that the conventional hot-pressed fuel body containing coated particles is unsuitable for hot-working. Migration of uranium through the pyrolytic-carbon coatings of the fuel particles occurs more rapidly than it does through the matrix graphite; thus, during the period required to hot-work the fuel body, the coatings are rendered useless and appreciable particle disruption occurs. Although micrographic observations of the hot-worked matrix graphite indicate a denser, less porous, and more highly oriented microstructure, measurements of the physical properties show no substantial improvements as a result of hot-working to moderate strain levels. Accordingly, it appears unprofitable to hot-work a conventional low-pitch graphite matrix containing fuel particles coated with pyrolytic carbon. Further studies, however, have shown that the hot-working process might be applied to obtain improved properties, using less expensive starting materials than in the conventional coated-particle fuel compact. Hot-worked bodies prepared with higher pitch contents show substantial improvements in physical properties. (JRD)

27200 (GEMP-530) HIGH TEMPERATURE MATERIALS ENGINEERING PROPERTIES EVALUATION (TASK 57017). Summary Report. Conway, J. B.; McCullough, W. L. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 18 Aug 1967. Contract AT(40-1)-2847. 45p. Dep. NTIS $4.25.

Declassified 21 Sep 1973.

The following were studied: mechanical properties of W–UO_2–ThO_2, Mo–$54UO_2$–$6ThO_2$, W–3Re–$54UO_2$–$6ThO_2$, Mo–50Re, W–30Re–30Mo, Ta and Ta–8W–2Hf; thermal expansion of W–25Re–30Mo and unclad and Ta-clad W–$54UO_2$–$6ThO_2$; and electric conductivity of Ta tubing and Ta-clad W–$54UO_2$–$6ThO_2$. (DLC)

27201 (RD/B/N-2512) MEASUREMENT OF THE DENSITY OF SMALL IRRADIATED SAMPLES. Shipp, R.; Bannister, G. H. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

The liquid concentration gradient technique for ceramic materials density measurement is described, together with the extension of the method to very dense materials by the use of low density carrier floats. The method is applied to the determination of the density profile across an irradiated fuel pellet from a series of six specimens, giving an accuracy of ±0.09 g/cm^{-3} in the comparison between specimens. It is seen that the greatest use of the technique is in the comparison of a range of similar specimens, rather than for absolute density determinations on individual specimens. The results obtained are compared with estimates of total porosity taken from a ceramographic section using a Quantimet image analyzing microscope. This suggests that the liquids used in the density column are able to penetrate the open porosity to a large extent, and thus the measured densities indicate the amount of closed porosity only. A general review of density column applications and of the methods used to produce the gradient is included. (auth)

27202 (RFP-Trans-152) PREPARATION AND PROPERTIES OF FILMS OF Y_2O_3 AND RARE EARTH OXIDES ON GLASS. Frank, B.; Groth, R. Translated from Thin Solid Films; 3: 41-50(1969). 7p. Dep. NTIS $3.00.

Thin films of Y_2O_3 and rare earth oxides have been prepared on glass substrates by the spray technique using acetylacetonates. Haze-free films with good adherence are formed at substrate temperatures higher than 400°C. These oxide layers show a crystalline structure with a preferred orientation. Their transmission has been measured in the region from the ultraviolet to the near infra-red and their indices of refraction have been

determined. The films have an excellent protective effect against corrosion of the glass substrate by hot alkali vapor. (auth)

27203 (RT/ING-(73)18) EXPERIMENTAL STUDY ON THE THERMAL BEHAVIOR OF FUEL RODS. Fuel-Cladding Gap Conductance and Conductivity Integral of UO_2-PuO_2 Pelleted Rods. Calza-Bini, A.; Cosoli, G.; Filacchioni, G.; Lanchi, M.; Nobili, A.; Rocca, U. V.; Rotoloni, P. L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 18 Dec 1973. 68p. (In Italian). Dep. NTIS (U.S. Sales Only) $6.50.

Results are given of the irradiation experiments carried out in the Siloè reactor on UO_2-PuO_2 pellet fuel rods. Measured values of conductivity integral and fuel-clad gap conductance are compared with results of other experiments on UO_2 pelleted samples. (auth)

27204 (SLA-73-5923) FORMATION AND PROPERTIES OF RARE-EARTH AND TRANSITION METAL HYDRIDES. Beavis, L. C.; Blewer, R. S.; Guthrie, J. W.; Nowak, E. J.; Perkins, W. G. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 12p. (CONF-740306-1). Dep. NTIS $3.00.

From hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

Research on metal hydrides indicates that surface chemical effects and dynamic thermal properties will play major roles in the use of these materials as hydrogen fuel storage media. Various techniques were developed to optimize the formation of metal hydride films, and near-surface analytical techniques including ion microprobe mass analysis, Auger electron spectroscopy, and proton backscattering were used to elucidate the surface chemistry of these materials. Thermal diffusivities were measured for hydrides of Sc, Y, Zr, and Er. (auth)

27205 (SLA-74-5114) PULSED IRRADIATION OF ENRICHED UO_2 IN THE ANNULAR CORE PULSE REACTOR (ACPR). Schmidt, T. R.; Lucoff, D. M.; Reil, K. O.; Croucher, D. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 5p. (CONF-740206-2). Dep. NTIS $3.00.

From Triga owner's conference; Albuquerque, New Mexico, USA (25 Feb 1974).

A series of experiments has been conducted in the Annular Core Pulse Reactor (ACPR) to determine the fission energy deposition and behavior of enriched UO_2 under pulse conditions. In the experiments single unirradiated pellets with enrichments up to 25 percent were pulse heated to melt temperatures. Temperature and fission product inventory measurements were made and compared with neutron transport calculations. (auth)

27206 TEMPERATURE DEPENDENCE OF ADHESION STRENGTH AND ELASTICITY OF SOME HEAT-RESISTANT COATINGS. Rishin, V. V.; Lyashenko, B. A.; Akinin, K. G.; Nadezhdin, G. N. (Inst. of Strength Problems, Kiev). Strength Mater. (USSR) (Engl. Transl.); 5: No. 1, 123-126(Jan 1973).

Translated from Probl. Prochnosti; 5: No. 1, 115-118(Jan 1973).

The dynamic resonance method was used to determine the temperature dependence of the modulus of elasticity of W, Mo, NiCr, and ZrO_2 coatings applied by the plasma spraying method. An increase in test temperature was found to cause a monotonic decrease in the modulus of elasticity. The absolute value of the modulus of elasticity for plasma-sprayed materials is lower than the corresponding value for the same materials applied by other methods (electron-beam melting, arc melting, and powder metallurgy methods). For W and Mo this difference, for example, was 15 to 20% which may be attributed to a difference in porosity, which also depends on coating thickness for plasma-sprayed material. It has been noted that the temperature dependence of the modulus of elasticity has two sections with different temperature coefficients. Thus, investigation results showed that the static adhesion strength of the combination base metal–coating obtained by the method of continuous plasma spraying, depends on the test temperature and coating thickness. It was shown that the modulus of elasticity of coating materials decreases during the temperature rise to 1200°C by 25 to 60% thereby affecting the cohesion strength of the combination. (auth)

27207 EVAPORATION BEHAVIOR AND METAL SELF-DIFFUSION PROCESSES IN (U,Pu)C AND $(U,Pu)O_2$. Matzke, H.; Lambert, R. A. (EURATOM, Karlsruhe, Germany). J. Nucl. Mater.; 49: No. 3, 325-328(Jan 1974).

It is noted that vapor pressures determine the initial evaporation rates of PuC–UC, and PuO_2-UO_2 fuels at about 2000°K, however, these are soon controlled by solid-state diffusion of the evaporating species toward the surface if diffusion is slower than evaporation. Results are presented to show that diffusion can be rate-controlling in building-up the concentration profiles of Pu in $(U,Pu)O_2$ and (U,Pu)C under conventional isothermal annealing conditions. The data serve in addition to indicate that the composition of near-surface layers of MO_2 and MC following annealing (e.g. sintering at high temperatures) can be different from that of the bulk. Care has therefore to be taken for any physical measurements (e.g. vapor pressure or optical measurements) on MC and MO_2 surfaces of samples that were preannealed at or above 1600°C, even if chemical analysis does not show a change in the (bulk) composition. (JRD)

27208 STABILITY CURVE FOR SHORT WAVELENGTH DENSITY FLUCTUATIONS OF DEUTERIUM IN NIOBIUM. Conrad, H. (Kernforschungsanlage, Juelich, Ger.); Bauer, G.; Springer, T.; Schmatz, W.; Alefeld, G. Z. Phys.; 266: No. 3, 239-244(1974).

By means of coherent cold neutron scattering, the temperature dependence of density of deuterium in niobium has been measured for three concentrations (2.3, 9.8, and 18% D/Nb). Depending on the scattering vector, the extrapolation to the stability curve for density fluctuations yields temperatures which are lower than the stability curve for macroscopic fluctuations. Both suppression and anisotropy of the short wavelength stability curves are attributed to the existence of elastic interaction between deuterium atoms. (GE)

27209 THERMAL DIFFUSIVITY OF US FROM 638 TO 1823 K. Nasu, S.; Takahashi, T.; Kikuchi, T. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Mater.; 49: No. 3, 257-261(Jan 1974).

The thermal diffusivity of uranium monosulfide was determined between 628 and 1823°K by a laser pulse method. Values for the thermal conductivity at 638 and 1823°K, calculated from the available data of the heat capacity, and corrected to theoretical density, were found to be 0.117 and 0.192 W/cm°K respectively. They were fitted to the sum of the electronic contribution and the lattice contribution to the thermal conductivity. The electrical resistivity was calculated by means of the Wiedeman–Franz law, using the Lorenz number for metallic conductors, assuming that the electronic part of the thermal conductivity was represented by the subtraction of the phonon part of the thermal conductivity, fitted by a computer, from the total thermal conductivity. The results agreed well with those of the direct measurements of electrical resistivity by other investigators. The Grüneisen anharmonicity parameter was also calculated from the value of the lattice contribution to the thermal conductivity, to be 1.07. (auth)

27210 RELATIONSHIP BETWEEN GAMMA AND DELTA HYDRIDES IN Zr-H ALLOYS OF LOW HYDROGEN CONCENTRATION. Nath, B.; Lorimer, G. W.; Ridley, N. (Univ. of Manchester, Eng.). J. Nucl. Mater.; 49: No. 3, 262-280(Jan 1974).

The stability of the γ-hydrides and the possible existence of a δ-hydride → γ-hydride transformation has been studied in sponge zirconium sheet containing up to 500 ppM hydrogen (4.33 at. %) at temperatures in the range 150 to 250°C. Aging of quenched specimens which initially contained only γ-hydrides resulted in the replacement of this phase by δ-hydrides at a rate which was dependent on temperature, while aging of the furnace-cooled specimen, which initially contained only δ-hydrides did not result in a change in the type of hydrides present. Evidence was obtained which showed that the replacement of γ-hydride by δ-hydride could involve an in-situ transformation. The results support the view that γ-hydride is a metastable transition precipitate and δ-hydride is the equilibrium phase. (auth)

27211 KINETICS AND MECHANISMS OF CARBON SELF-DIFFUSION IN URANIUM CARBIDES. Sarian, S. (Univ. of Washington, Seattle). J. Nucl. Mater.; 49: No. 3, 291-298(Jan 1974).

Depending upon the temperature, uranium carbide, UC_x, has the B1 (NaCl type) crystal structure and is characterized by a wide range of the carbon-to-uranium ratio ($0.95 < x < 2.0$). The kinetics of carbon diffusion in uranium carbides are examined and mechanisms are proposed which explain the diffusivities determined by numerous investigators for compositions in the range $0.95 < x < 2.0$. When the composition is hypostoichiometric, the defect structure in the carbon sub-lattice consists of constitutional vacancies; the concentration of these vacancies is fixed by the carbon-to-uranium ratio and equals $(1 - x)$. Carbon diffusion occurs by the random migration of carbon atoms from one octahedral site to an adjacent vacant octahedral site. The defect structure in the carbon sub-lattice of stoichiometric and hyperstoichiometric uranium carbides consists of C_2 groups and single carbon atoms in the octahedral sites; the concentration of unoccupied octahedral sites (vacancies) is negligibly small. Diffusion occurs by the random migration of single carbon atoms from doubly occupied sites to adjacent singly occupied octahedral sites. Quantitative expressions of these mechanisms are developed which accurately describe the diffusion kinetics. The preponderant discordance in the experimental results of other in-

vestigators are reviewed and examined; it is concluded that the wide variability in these results was probably caused by microstructural effects. (auth)

27212 KINETICS OF DEHYDRATION OF YH_x IN VACUUM BETWEEN 550 AND 950°C. Jung, J. J. Nucl. Mater.; 49: No. 3, 299-308(Jan 1974). (In German).

The time-dependence of the dehydridation of YH_x was determined by means of vacuum-heat extraction, for the composition range $0 \leq x \leq 2$. It was shown that the rate of dehydridation is determined by the molecular recombination of hydrogen adsorbed at the sample surface, or else by the desorption of H_2 molecules from the surface. Hydrogen release, which was measured for spherical, plate-shaped or cylindrical samples, follows zero-order kinetics in the $YH_{2-\gamma}$ and $(\alpha - H + YH_{-2})$ phase fields. In the two-phase field, as compared with the $YH_{2-\gamma}$ field, the dehydridation rate is greater by a factor 4.7; the activation energy is 65 kcal/mole. The hydrogen release from α-Y solid solutions can be described by second-order kinetics if the condition of a low surface occupancy by hydrogen applies. The temperature dependence leads to an "activation energy" of 67 kcal/mole. (auth)

27213 FREE ENERGY OF FORMATION OF $UMoC_2$ AND PHASE BEHAVIOR IN THE U-Mo-C SYSTEM. Naraine, M. G.; Bell, H. B. (Univ. of Strathclyde, Glasgow). J. Nucl. Mater.; 49: No. 3, 329-332(Jan 1974).

The composition range and free energy of formation of $UMoC_2$ were studied. Results show that the compound $UMoC_2$ is the only low-temperature equilibrium ternary compound in the U-Mo-C system and that this compound shows non-stoichiometric behavior at temperatures above 1400°C. This probably extends to its melting point. (JRD)

27214 TERNARY $UReC_{2-x}$ COMPOUND. Alexeyeva, Z. M. (Inst. of Metallurgy, Moscow). J. Nucl. Mater.; 49: No. 3, 333-336(Jan 1974).

Results of studies of the U-Re-C system are presented that reveal a formerly undefined compound represented as $UReC_{2-x}$. Data are included on spacings for the zero-order line of the $UReC_{2-x}$ monocrystal and indexing x-ray power patterns of $UReC_{2-x}$ compound. It is noted that the isomorphous series of monoclinic compounds of the $UMoC_{2-x}$ type, which formerly consisted of the two compounds $UMoC_{2-x}$ and UWC_{2-x} has been extended owing to the newly discovered $UReC_{2-x}$. (JRD)

27215 BASIC TUNGSTATES OF THE RARE EARTH ELEMENTS. Golub, A. M.; Maksin, V. I.; Solomakha, V. N.; Aganiyazov, K. (Kiev State Univ.). Zh. Neorg. Khim.; 18: No. 12, 3203-3204(Dec 1973). (In Russian).

By pH potentiometry, electroconductivity measurements of the liquid phase, and chemical analysis of the precipitates formed in the system, the systems $R(NO_3)_3-K_2WO_4-KOH-H_2O$, where R = Sc, Y, and Er, are studied at $[K_2WO_4] = [KOH]$ = constant and variable concentration of $R(NO_3)_3$. The formation of the salts $R(OH)WO_4$ is established. On the basis of the experimental data the optimum conditions are found for the preparation of the hydroxytungstates $R(OH)WO_4.xH_2O$ where R is Sc, Y, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu and x = 1.5 to 2.5. These compounds are investigated by x-radiographic and differential-thermal methods. The interplanar spacings are calculated and the isomorphism of the compounds is established. (tr-auth)

27216 INTERACTION OF SODIUM CARBONATE WITH VANADIUM OXIDES. Volkov, V. L.; Valikhanova, N. Kh.; Fotiev, A. A. (Kiev State Univ.). Zh. Neorg. Khim.; 18: No. 12, 3208-3209(Dec 1973). (In Russian).

The reaction capacity of sodium carbonate is studied with respect to vanadium oxides changes in the series V_2O_5, V_3O_7, V_6O_{13}, and V_2O_4 that is associated with the growth of the number of electrons in the vanadium oxides which probably participate in the formation of new chemical bonds. The lowest rate of the process is observed in the $Na_2CO_3-V_2O_3$ system which is explained by the formation of solid solutions with the composition $Na_{0.33}V_2O_{3.17}$. In this case the incorporation of Na^+ ions into the vacancies of the crystalline lattice of V_2O_3 and the addition of O^{2-} ions after destruction of the anion grouping $[CO_3]^{2-}$ occur. The activation energies for the interaction of Na_2CO_3 with V_2O_5, V_3O_7, V_6O_{13}, V_2O_4, and V_2O_3 are 28.0, 26.5, 25.5, 22.5, and 21.0 ± 0.5 kcal/mol respectively. (tr-auth)

27217 PbO-B_2O_3-WO_3 SYSTEM. Mal'tsev, V. T.; Bergman, A. G.; Chobanyan, P. M.; Volkov, V. L. Zh. Neorg. Khim.; 18: No. 12, 3314-3318(Dec 1973). (In Russian).

The ternary system PbO-B_2O_3-WO_3 is studied by thermal, x-ray phase, and optical methods. The fields of primary crystallization of the original components and the binary compounds $PbO \cdot WO_3$, $2PbO \cdot WO_3$, $4PbO \cdot B_2O_3$, $2PbO \cdot B_2O_3$, $5PbO \cdot 4B_2O_3$, and $PbO \cdot 2B_2O_3$ and one ternary compound melting congruently at 780°C with the composition $15PbO \cdot 3B_2O_3 \cdot 2WO_3$ are determined. The range of the diagrams with increased tendency of the melts to form glass is defined. The optical properties of some glasses are determined. The range of stratification of the melts is defined. A topological analysis of the systems is given. (tr-auth)

27218 PbO-V_2O_5-WO_3 SYSTEM. Mal'tsev, V. T.; Volkov, V. L.; Morgulis, T. V. (Rostov Engineering-Construction Inst., USSR). Zh. Neorg. Khim.; 18: No. 12, 3355-3357(Dec 1973). (In Russian).

The ternary system PbO-V_2O_5-WO_3 was studied by thermal and x-ray phase methods with the sides of the phase triangle being limited by the binary $V_2O_5-WO_3$ system. The fields of crystallization of the original components and the binary phases are determined. Six non-variant ternary points, three of which are the eutectic type and three of the peritectic type, are established. X-ray phase analysis of the solid phase of the $V_2O_5-WO_3$ system shows the absence of chemical interaction between the components. (tr-auth)

27219 ELECTRON PARAMAGNETIC RESONANCE OF THE SYSTEM $V_2O_3-VO_2$. Balyakov, Yu. M.; Perelyaev, V. A.; Chirkov, A. K.; Shveikip, G. P. (Ural Scientific Center, Sverdlovsk, USSR). Zh. Neorg. Khim.; 18: No. 12, 3360-3361(1973). (In Russian).

The EPR spectra of the oxides VO_x (x = 1.5 to 2.0) are obtained. With increase of x the g-factor is increased from 1.936 to 1.964 but the line widths decrease from 329 to 256 gauss. It was assumed that the EPR signals are caused by V^{4+} ions. (tr-auth)

27220 CONSIDERATIONS ON OXYGEN DISTRIBUTION IN HYPOSTOICHIOMETRIC MIXED-OXIDED FUEL PINS. Bober, M.; Schumacher, G. (Kernforschungszentrum, Karlsruhe, Germany). J. Nucl. Mater.; 49: No. 3, 322-324(Jan 1974).

Results post-irradiation measurements of O distribution in PuO_2-UO_2 fuels are compared with calculations of O distribution in such fuels using thermal diffusion data. The data are presented graphically and analyzed. (JRD)

27221 PHOTOCONDUCTIVITY STUDIES OF NATIVE DEFECTS AND DEFECTS CREATED BY ELECTRON-IRRADIATION IN N-TYPE CdTe. Caillot, M. (Ecole Normale Superieure, Paris). pp 13.1-13.7 of International Symposium on Cadmium Telluride: A Material for Gamma-Ray Detectors. Siffert, P. (ed.). Strasbourg; Centre National de Recherches Nucleaires (1972).

From conference on cadmium telluride: a material for gamma-ray detectors; Strasbourg, France (29 Jun 1971).

Photoconductivity experiments were conducted with n-type CdTe both before and after irradiation by 1.5 MeV electrons. The levels associated with intrinsic defects present before irradiation are: $E_c-0.6eV$, E_c-1eV, $E_c-0.42eV$. After irradiation , a jump in photoconductivity occurs at 0.6eV followed by a growth phase and a new level appearing at E(vacancy) = +0.46eV. Two factors influence the annealing behavior of the 0.6eV level, the first being due to an intrinsic defect (vacancy $(Cd)^+$ impurity) which is not affected by irradiation and the second being due to a defect produced by the irradiation which involves a Cd vacancy and recovers completely at 200°K. The level at E(vacancy + 0.46eV) is attributed to a Te vacancy which recovers at about 77°K. (FR)

27222 DIFFUSION OF TRITIUM IN RUTILE (TiO_2). Caskey, G. R. Jr. (E. I. du Pont de Nemours and Co., Aiken, SC). Contract AT(07-2)-1. Mater. Sci. Eng.; 14: 109-114(1974).

Tritium diffusion in single crystals of rutile (TiO_2) was measured at temperatures between 155 and 300°C. Diffusivities were calculated from concentration profiles obtained from microdensitometer traces of autoradiographs generated by the β-decay of the tritium. Diffusivity is anisotropic with estimated diffusion equations of: $D_c = 7.5 \times 10^{-6} \exp(-9040/RT)$, and $D_a = 2.7 \times 10^{-6} \exp(-13,100/RT)$. (auth)

27223 HIGH TEMPERATURE CERAMIC COMPOSITION FOR HYDROGEN RETENTION. Webb, R. W. (to United States Atomic Energy Commission). US Patent 3,784,384. 8 Jan 1974. Filed date 17 Mar 1964. 6p.

A ceramic coating for H retention in fuel elements is described. The coating has relatively low thermal neutron cross section, is not readily reduced by H at 1500°F, is adherent to the fuel element base metal, and is stable at reactor operating temperatures. (JRD)

27224 THERMAL CONDUCTIVITY OF SUBSTOICHIOMETRIC ZrC AND NbC. Storms, E. K.; Wagner, P. (Los Alamos Scientific Lab., NM). High Temp. Sci.; 5: No. 6, 454-462(Dec 1973).

The thermal conductivity at 300°K of ZrC_{1-x} and NbC_{1-x} was measured as a function of x. At low carbon contents within the single phase cubic phase, the thermal conductivity of both compounds is near 7 W/mK and nearly independent of carbon content.

Near the upper phase boundary the thermal conductivity increases rapidly as the vacancies in the carbon sublattice are filled. The highest measured conductivities for the two compounds are 45.8 W/mK for $ZrC_{0.982}$ and 23.2 W/mK for $NbC_{0.973}$. (auth)

27225 HIGH-TEMPERATURE PROPERTIES OF THE Th–O SYSTEM: REVISION OF THERMODYNAMIC PROPERTIES OF ThO(g) AND ThO_2(g). Ackermann, R. J.; Rauh, E. G. (Argonne National Lab., IL). High Temp. Sci.; 5: No. 6, 463–473(Dec 1973).

The thorium–oxygen system has been studied by investigating the vaporization behavior of the dioxide phase and the univariant system, Th(l) + ThO_2(s). A combination of mass effusion and mass-spectrometric techniques was employed to yield an internally consistent set of thermodynamic data. At 2800°K there is a measurable but thermodynamically insignificant departure from stoichiometry of the dioxide, $ThO_{1.994}$. The activities of the coexisting liquid metal and dioxide phases below 2400°K are essentially unity. The partial pressures of ThO(g), Th(g), and O(g) over the univariant system were determined in the temperature range 1800 to 2400°K and the equilibrium constant for the isomolecular exchange reaction, YO(g) + Th(g) = Y(g) + ThO(g), was evaluated as a function of temperature over the range 1940 to 2300°K; these results were combined with thermal data to evaluate the standard free energy of formation of ThO(g) from 1600 to 3000°K. The dissociation energy of ThO(g) is 9.0 ± 0.1 eV. The partial pressures of ThO_2(g), ThO(g), and O(g) over the congruently evaporating dioxide phase and the standard free energy of formation of the gaseous dioxide were established. In the temperature range 2400–2800°K, the standard free energies of formation are given by the linear equations: $\Delta G_T^\circ(ThO,g) = -16{,}550 - 12.15\ T$, $\Delta G_T^\circ(ThO_2,g) = -132{,}120 + 7.23\ T$. The appearance potentials, measured by electron impact, of Th^+, ThO^+, and ThO_2^+ are, respectively, 5.9, 6.1, and 8.7 eV with an estimated uncertainty of 0.1 to 0.2 eV. (auth)

27226 THERMODYNAMIC AND PHASE RELATIONSHIPS OF THE Zr–U–C SYSTEM. Storms, E. K.; Griffin, J. (Los Alamos Scientific Lab., NM). High Temp. Sci.; 5: No. 6, 423–437(Dec 1973).

The uranium activity in $U_xZr_{1-x}C$ + C was measured as a function of uranium content and temperature using a high temperature mass spectrometer. Both the uranium and zirconium activities were determined in the ternary mixture UZrC (cubic solution) + UC_2 + C. In addition to the thermodynamic information, the phase boundary of the solid solution in the presence of graphite and UC_2 was determined between 2000 and 2400°K. The solution between $ZrC_{1.0}$ and $UC_{1.0}$ was found to be ideal at 2190°K with an increasingly positive enthalpy of mixing as the temperature is increased. Most of the stability of the solution apparently results from the metal–carbon interaction with a repulsive contribution from the metal–metal interaction above 2190°K. At 2300°K the phase boundary of the solution in equilibrium with β–UC_2 and graphite lies near 22 mole % UC. This boundary moves to lower uranium contents as the temperature is raised. The equilibrium loss rate for uranium was so high compared with zirconium that if a congruently vaporizing composition exists, it must contain much less than 0.5 mole % UC. Nitrogen rich samples produced small quantities of the previously unreported UCN gaseous specie as well as UN and UC_2. (auth)

27227 RAMAN SCATTERING STUDY OF CRYSTALLIZATION AND PHASE TRANSFORMATIONS OF ZrO_2. Keramidas, V. G.; White, W. B. (Pennsylvania State Univ., University Park). J. Amer. Ceram. Soc.; 57: No. 1, 22–24(Jan 1974).

From 75th annual meeting, The American Ceramic Society; Cincinnati, OH (30 Apr 1973).

X-ray diffraction, electron diffraction, and Raman scattering measurements are presented for dehydrated amorphous ZrO_2. Although the material lacks sufficient crystallinity to diffract x rays, electron diffraction patterns indicate a microcrystallinity with a grain size of 15 to 30 Å. Raman spectra characteristic of the metastable tetragonal polymorph were obtained from these materials. Heating the amorphous materials induces recrystallization into first a metastable tetragonal phase and then the stable monoclinic phase. (auth)

27228 POLYMORPHIC TRANSFORMATION OF Eu_2O_3 BY ABRASION. Ross, W. A.; Gibby, R. L. (Westinghouse Hanford Co., Richland, WA). J. Amer. Ceram. Soc.; 57: No. 1, 46–47 (Jan 1974).

Observations of transformations in Eu_2O_3 are discussed indicating that care must be taken in preparing a sample of polymorphic material for phase identification by x-ray diffraction. Preparation of a powder or surface for x-ray diffraction by grinding or abrasion may yield results which do not represent the true composition of the bulk specimen. (JRD)

27229 THERMAL-SHOCK STRUCTURES IN A PARTIALLY STABILIZED ZrO_2 IN THE SYSTEM CaO–ZrO_2. El-Shiekh, A. M.; Nicholson, P. S. (McMaster Univ., Hamilton, Ont.). J. Amer. Ceram. Soc.; 57: No. 1, 19–22(Jan 1974).

The stress-relieving mechanisms in two batches of thermal-shock-resistant ZrO_2 partially stabilized by CaO were investigated by electron-optical replication techniques. In one batch of material, thermal shock produces a high density of microcracks; this behavior is interpreted as resulting from the brittle nature of the matrix cubic phase. In the other batch of material, thermal shock produces coherent "bumps," suggesting that the material acts in a ductile fashion. (auth)

27230 PREPARATION OF URANIUM CARBIDE. I. By Carbothermic Reduction of Oxide. Gorle, F. (SKC/CEN, Boeretang, Belgium); Timmermans, W.; Ahmed, M.; Brabers, M. Amer. Ceram. Soc. Bull.; 53: No. 3, 234–236(Mar 1974).

The carbothermic reduction by carbon of UO_{2+x}, U_3O_8, and UO_2–V_2O_5 mixtures was studied as a function of heating rate under vacuum or in an inert gas atmosphere. The CO and CO_2 evolution during reaction and the resulting oxygen content of the final product was followed as a function of the procedure. The reduction was found to be diffusion-controlled. Ball-milling time and heating process are important factors in the preparation; for U_3O_8, success depends on complete reduction to UO_2 at low temperature. 1800°C under vacuum is required to lower the oxygen content below 400 ppM. U–C–V mixtures containing 1000 ppM O can be made. (6 figures, 2 tables) (DLC)

27231 PREPARATION OF URANIUM CARBIDE. II. By Reduction of Fluoride. Gorle, F. (SCK/CEN, Boeretang, Belgium); Ooms, H.; Brabers, M. Amer. Ceram. Soc. Bull.; 53: No. 3, 237–238(Mar 1974).

In an effort to eliminate O contamination when carbides are prepared by carbothermic reduction of oxides, experiments and calculations were carried out on the conversion of UF_4 to UC. Reduction by Si or Al in the presence of C occurs at 1000°C and goes to completion, and the residual fluoride content is below the detection limit. However, UC yield is low due to fluoride volatility; it never exceeded 80% in the experiments, which is much lower than in reduction of PuO_2 by C. (DLC)

27232 MECHANICAL AND PHYSICAL PROPERTIES OF SEVERAL ADVANCED METAL-MATRIX COMPOSITE MATERIALS. Christian, J. L.; Campbell, M. D. (General Dynamics, San Diego, CA). Advan. Cryog. Eng.; 18: 175–183(1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

Mechanical and physical properties were determined at room, cryogenic, and elevated temperatures on several advanced metal-matrix composite materials. These included boron/aluminum, BORSIC/aluminum, BORSIC/titanium/aluminum, and BORSIC/stainless steel/aluminum. Mechanical property results indicated that each composite material tested shows good strength and modulus-to-density properties compared with conventional engineering alloys. The effects of test temperature were generally as expected; i.e., increased strength with decrease in temperature. Physical property test results indicated small coefficients of linear thermal expansion for the composite materials, particularly for the longitudinal directions. Specific heat results were as expected based upon material compositions. (auth)

27233 BORON CARBIDE DUST FLAMES. Bryant, J. T. (Naval Weapons Center, China Lake, CA). Combust. Sci. Technol.; 5: No. 6, 287–290(Aug 1972).

The total burning time of boron carbide powder has been measured in premixed laminar boron carbide-propane-oxygen-nitrogen flames of atmospheric pressure. Burning times were several times longer than for elemental boron of the same particle size and were even longer than predicted by extrapolation from larger single-boron carbide particle burning experiments. Several possible explanations for this discrepancy are discussed. (auth)

27234 THERMAL EVOLUTION SPECTROMETRY OF LOW ENERGY INERT GAS IONS INJECTED INTO POLYCRYSTALLINE UO_2. Cavaleru, A. O. R.; Armour, D. G.; Carter, G. (Institutul de Fizica Atomica, Bucharest). Vacuum; 24: No. 1, 13–21(Jan 1974).

Low-energy ions were injected into sintered UO_2 and the probabilities of the entrapment measured as a function of ion energy from 50 eV to 3 keV, by heating the targets after irradiation and recording the ratio of quantity of gas released to incident ion fluence. Values of entrapment probability increase from zero at low ion energies to about unity at 1 keV. The rate of thermal gas evolution was also recorded as a function of temperature during the post-bombardment target tempering, enabling deduction of activation energies for evolution. These activation energies are correlated with published data on the annealing of point and extended defects in the solid and with self-diffusion energies. (auth)

27235 IRRADIATION EFFECTS IN AMORPHOUS ZrO_2. Leteurtre, J.; Soullard, J. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Radiat. Eff.; 20: No. 3, 175-180 (Nov 1973).

Amorphous ZrO_2 was irradiated in order to study thermal spikes first produced by electronic excitation and then in displacement cascades. The crystallization of amorphous ZrO_2 was studied first by heating it in a furnace. These effects were then compared with radiation-induced effects. Tracks of noncrystalline structure were observed in amorphous ZrO_2 irradiated with fission fragments at low dose. The threshold stopping power of fission fragments leaving a track was determined to be 1300 eV/Å. White spots were also observed in amorphous ZrO_2 irradiated with 1-MeV Kr^+ ions. They exhibit, in electron microscopy, a more intense transmission than the amorphous matrix. It is shown that displacement spikes are responsible for these spots and that the atomic order is higher in these spots than in the amorphous matrix. The threshold energy, for a primary to create a displacement spike able to induce such a spot, was found to be 50 keV. (auth)

27236 LONG-PERIOD ORDER IN VANADIUM CARBIDE. Lewis, M. H.; Billingham, J. (Univ. of Warwick, Coventry, Eng.). Phil. Mag.; 29: No. 2, 241-252(Feb 1974).

Periodic arrangements of anti-phase boundaries (APBs) were detected by electron diffraction and microscopy in long-range ordered crystals of vanadium carbide near to the composition V_8C_3. The APBs were nonconservative and were believed to accommodate excess vacancies or carbon atoms in response to deviations in crystal composition from V_8C_3. The atomic arrangement at nonconservative APBs was deduced from diffraction contrast analysis of isolated APBs and their observed configurations in crystals containing nonperiodic distributions. The observed variation in spacing of the long-periodic structure was consistent with analyses of the average crystal compositions. A mechanism of formation of the long-period structure was deduced from observations on partially transformed crystals. (auth)

27237 INFLUENCE OF VACUUM, CARBON MONOXIDE, AND HYDROGEN ON CERIA AND ZINC DOPED CERIA-ELECTRON SPIN RESONANCE STUDY. Gideoni, M.; Steinberg, M. (Hebrew Univ., Jerusalem). Israel J. Chem.; 11: No. 4, 543-547(1973).

The effects of heating in vacuum, carbon monoxide, and hydrogen on cerium(IV) oxide and zinc oxide-doped cerium(IV) oxide were investigated by ESR, and a difference in the behavior of the signals obtained for the two preparations was observed. The signal decrease $g = 1.940$ and $g = 1.961$ was faster and was obtainable at lower temperatures for the doped oxide than for the undoped sample. The effect of oxygen on these samples is reported and a mechanism is proposed. (auth)

27238 ELECTRON SPIN RESONANCE STUDY OF THE $(OF)^{2-}$ MOLECULAR ION IN NEUTRON-IRRADIATED ^{17}O-ENRICHED MgO. Rius, G.; Cox, R. T.; Freund, P.; Owen, J. (Centre d'Etudes Nucleaires, Grenoble, France). J. Phys., C (London); 7: No. 3, 581-588(7 Feb 1974).

A paramagnetic defect which was proposed previously to be a ⟨111⟩ oriented $(OF)^{2-}$ molecular ion has been produced by neutron irradiation in an MgO crystal enriched in ^{17}O. An ESR study shows that the defect has an axially symmetric hyperfine interaction with an ^{17}O nucleus. The principal values of the hyperfine tensors are $|A_\parallel| = (110 \pm 4) \times 10^{-4}$ cm^{-1} and $|A_\perp| = (14 \pm 3) \times 10^{-4}$ cm^{-1}. The $(OF)^{2-}$ model is confirmed by an analysis of the ^{17}O and ^{19}F hyperfine tensors and of the g tensor, using the theory developed for the isoelectronic molecules F_2^-, FCl^-, etc. The $(OF)^{2-}$ molecule occupied a single anion site; it appears likely that it is formed by trapping of an interstitial oxygen at a substitutional fluorine. (auth)

27239 PRODUCT AND PROCESS FOR EUROPIUM-ACTIVATED RARE EARTH PHOSPHOR. Nath, D. K.; Wolk, J. R. (to General Electric Co.). US Patent 3,798,173. 19 Mar 1974. Filed date 3 Jun 1971. 8p.

Europium oxide-activated rare earth phosphors are prepared having improved physical properties including uniform particle size of the phosphor crystals, brighter emission, and less electrical conductivity than can be obtained by conventional methods of preparation. The phosphor crystals are grown in the presence of a vitreous flux composition which is an alkali borosilicate material having a vitreous phase. The vitreous flux can be formed in situ by mixing the constituent materials with the rare earth oxides and heating the mixture to the firing temperature at which the phosphor crystals are formed or a preformed vitreous flux can be mixed with the rare earth oxides and the same firing schedule carried out. The final product can contain up to 15 wt % vitreous flux in the luminescent material for optimum performance and said vitreous flux forms a coating on the phosphor crystals. (Official Gazette)

27240 PHASE EQUILIBRIUM IN ALLOYS OF VANADIUM WITH TITANIUM, ZIRCONIUM, AND HAFNIUM NITRIDES. Shurin, A. K.; Barabash, O. M. (Inst. of Metal Physics, Kiev). Metallofizika; No. 45, 84-87(1973). (In Russian).

A study was made of the phase composition of ternary cast and annealed alloys of vanadium with nitrogen and Group IVA metals (Ti, Zr, Hf) in the composition range V–VN, MeN, V_2Me with the use of metallographic, x-ray, local x-ray spectrum, and differential thermal analysis. Isothermal sections of the triangular diagram of state at 1200°C and polythermic sections of V–MeN, which are quasi-binary and have a eutectic nature were constructed. (tr-auth)

27241 PREPARATION AND PROPERTIES OF TWIN FILMS OF THE SYSTEM $Nb-Al_2O_3$. Osipov, K. A.; Borovich, T. L.; Miroshkina, E. M. (Inst. of Metallurgy, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 9, 1339-1341(Sep 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 9, 1503-1505(Sep 1973).

Using the electron-beam method, films of niobium and aluminum oxide were codeposited containing 15 to 98 at.% Nb, with a resistivity of 5×10^{-4} to $4\ 10^3\ \Omega \cdot$ cm and a temperature coefficient (TCR) in the range from 1×10^{-3} to -5×10^{-3} deg^{-1} at 25–100°C. Films with 70 to 90 at.% Nb have the minimum absolute TCR; heating such films changes the sign of the TCR from negative to positive. The dielectric constant and the dielectric loss tangent in high-ohmic films varied respectively from 10 to 25 and from 0.2 to 0.42 with increasing niobium content. (auth)

27242 SURFACE TENSION AND DENSITY OF Al_2O_3-BeO MELTS. Elyutin, V. P.; Mitin, B. S.; Anisimov, Yu. S. (Moscow Inst. of Steel and Alloys). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 9, 1408-1410(Sep 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 9, 1585-1587(Sep 1973).

The concentration dependences of the surface tension and density of liquid melts of the system Al_2O_3-BeO were determined. The variation of the surface tension and density of pure aluminum oxide and melts of the system Al_2O_3-BeO with temperature was also measured. (auth)

27243 EFFECT OF FLUORINE ON THE MICROSTRUCTURES OF PHOSPHATE GLASSES. Petrovskii, G. T.; Urusovskaya, L. N.; Yudin, D. M. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 9, 1437-1440(Sep 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 9, 1615-1620(Sep 1973).

In alkali aluminosphosphate glasses, when oxygen is replaced by fluorine, there is an increase in the intensity of the gamma-irradiation-induced EPR lines, showing that there is additional rupture of –P–O–P bonds, i.e., that the PO_3F groups in these glasses are terminal. In barium aluminophosphate glasses, when oxygen is replaced by fluorine the intensities of these lines decrease, which may be associated with chain elongation, i.e., the fluorine is a binding element in them. The EPR signals of complexes of trivalent phosphorus in barium glasses are weaker than those in alkali glasses; replacement of oxygen by fluorine has practically no effect on the intensity of the signals of P(III) in barium glasses. When oxygen is replaced by fluorine, the intensity of the EPR signals decreases in the sequence potash–soda–lithium glasses. This shows that fluorine is best retained in potash glasses. (auth)

27244 VISCOSITY AND ELASTIC PROPERTIES OF GLASSES BASED ON THE SYSTEMS $GeO_2-La_2O_3-Ga_2O_3$ AND $GeO_2-La_2O_3-Ta_2O_5$. Nemilov, S. V.; Komarova, N. V. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 9, 1444-1448(Sep 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 9, 1624-1628(Sep 1973).

The character of the change in the viscosity is correlated with the form of the phase diagram. The glasses have a refractoriness 100 to 150°C higher than that of glasses on a boron-lanthanum basis; like the latter, they are "short" glasses. When the components are replaced by oxides of elements of groups III-V, the refractoriness of the glasses either increases or decreases, according to the ratio of the atomization energies of the oxides and to the position of the phase diagram. The shear moduli of these glasses are much higher than those of silicate glasses. However, the proportionality of the shear modulus and the softening point, characteristic of silicate systems, is also observed for germanate glasses. This is due to involvement of oxygen atoms of similar volume in elementary acts of activation of flow. (auth)

27245 FUSIBILITY OF THE SYSTEMS $PbF_2-M_2O_3$ AND $PbO-Y_2O_3$. Sapozhnikov, Yu. L.; Titova, A. G. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 9, 1466-1468(Sep 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 9, 1644-1645(Sep 1973).

Reactions of PbF_2, a fluxing agent, with Fe_2O_3, Al_2O_3, Sc_2O_3, Ga_2O_3, and Y_2O_3 were investigated using the liquidus and fusibility curves. For Fe_2O_3, the eutectic was 92% PbF_2, melting at 507°C. No reaction was found for Al_2O_3, Sc_2O_3, and Ga_2O_3. Single crystals of $\beta-Ga_2O_3$ were grown as plates. For Y_2O_3, the eutectic is 5% Y_2O_3, melting at 830°C. (DLC)

27246 SYSTEMS La–Cr–B AND Ce–Cr–B. Kuz'ma, Yu. B.; Svarichevskaya, S. I.; Fomenko, V. N. (Lvov State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 9, 1372-1374(Sep 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 9, 1542-1545(Sep 1973).

X-ray structural and microstructural analysis was used to investigate the systems La–Cr–B and Ce–Cr–B and to construct the isothermal cross sections at 800°C–Cr–B containing more than 45 at.% Ce was also investigated at 600°C. It was found that the system Ce–Cr–B contains two ternary compounds: the structure of $CeCr_2B_2$ is of a new type (space group $Immm-D_{2h}^{25}$; a = 6.560 ± 0.004 Å; b= 8.318 ± 0.005 Å; c = 3.102 ± 0.003 Å), while that of $CeCrB_4$ is of the $YCrB_4$ type (a = 5.974 ± 0.005 Å; b = 11.53 ± 0.01 Å, c = 3.536 ± 0.004 Å. (auth)

27247 ELECTRICAL CONDUCTIVITY AND STRUCTURE OF VACUUM CONDENSATES OF CARBIDES OF TITANIUM, ZIRCONIUM, AND NIOBIUM. Fat'yanov, V. M.; Ushakova, S. E.; Astapchik, S. A.; Sychev, G. T. (Physical-Technical Inst., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Tekh. Navuk; No. 3, 44-47 (1973). (In Russian).

Effect of the condensation conditions and, in particular, the substrate temperature on the structure and thermal stability of the properties of thin films (1 to 5 microns) of carbides of refractory metals was studied. The study was performed on condensates of the carbides of titanium, zirconium, and niobium. On the basis of a study of electrical-conductivity variations and of the results of x-ray structural and electron-microscopic analyses, it is concluded that condensates obtained at substrate temperatures ranging from 550 to 600°C possess a quasi-equilibrium structural state which ensures stability of the electrical conductivity during subsequent cyclic heatings and coolings in the temperature range from 20 to 600°C. (IAA)

27248 TEMPERATURE DEPENDENCES OF THE ELASTIC CONSTANTS OF NONSTOICHIOMETRIC ZIRCONIUM CARBIDES. Baranov, V. M.; Knyazev, V. I.; Korostin, O. S. (Moscow Engineering–Physics Inst.). Probl. Prochnosti; 5: 45-47(Sep 1973). (In Russian).

The temperature dependence of the modulus of elasticity and the Poisson ratio of zirconium carbides $ZrC_{0.77-0.96}$ are studied at temperatures ranging from 20 to 2100°C. The modulus of elasticity and the Debye temperature are found to increase linearly with increasing carbon concentration. An expression describing the behavior of the modulus of elasticity as a function of the temperature is proposed. The increase in Poisson ratio with increasing temperature is very small. (IAA)

27249 CONDUCTING PROCESSES IN ANODIC TANTALUM OXIDE. Aris, F. O.; Lewis, T. J. (Univ. College of North Wales, Bangor). pp 115-124 of Electrical, Magnetic, and Optical Ceramics. London; British Ceramic Society (1972).

From conference on electrical magnetic and optical ceramics; London, UK (13 Dec 1972). See CONF-721216-.

Specimens were prepared by anodizing 10-μm Ta foils. The bias conductivity was investigated in both forward and reverse bias. A space-charge-limited-current behavior was observed in forward bias. Results indicate that the conductivity is not confined to the flaws. The distribution of the traps in the band gap of Ta_2O_5 is discussed. (8 figures, 21 references) (DLC)

27250 CERAMIC AND DIELECTRIC PROPERTIES OF SELECTED COMPOSITIONS IN THE $BaO-TiO_2-CeO_2$ SYSTEM. Kolar, D.; Guha, J. P.; Buh, M. (Univ. of Ljubljana, Yugoslavia). pp 152-155 of Electrical, Magnetic, and Optical Ceramics. London; British Ceramic Society (1972).

From conference on electrical magnetic and optical ceramics; London, UK (13 Dec 1972). See CONF-721216-.

In an investigation of the $BaO-TiO_2-CeO_2$ system, a ternary eutectic was found to occur close to $BaTiO_3$, which decreases the sintering temperature of these compositions. Densification and microstructure development of several compositions in this system were investigated and the results were correlated with the dielectric properties. The shift of Curie temperature of $BaTiO_3$ by the addition of CeO_2 is more pronounced in the presence of excess TiO_2. The addition of CeO_2 in the form of $BaCeO_3$ to $BaTiO_3$ causes broadening of the temperature interval with a high value of the dielectric constant. Both effects could be used to modify the ferroelectric properties of $BaTiO_3$. (7 figures) (auth)

27251 PHASE-EQUILIBRIUM DIAGRAM FOR THE SYSTEM $Gd_2O_3-MoO_3$. Megumi, K.; Yumoto, H.; Ashida, S.; Akiyama, S.; Furuhata, Y. (Hitachi, Ltd., Tokyo). Mater. Res. Bull.; 9: No. 4, 391-400(Apr 1974).

Phase equilibria were established in the binary system $Gd_2O_3-MoO_3$ including $Gd_2(MoO_4)_3$ with ferroelectricity and ferroelasticity below 159°C, by means of differential thermal analysis and x-ray powder diffraction techniques. It is shown that $Gd_2(MoO_4)_3$ has no solubility of other compounds in this system and melts congruently on its stoichiometric composition. Three distinct intermediate compounds were found. $Gd_2O_3 \cdot 6MoO_3$ and $Gd_2O_3 \cdot 4MoO_3$ are formed by a peritectic reaction at 730 and 825°C, respectively. The remaining compound $Gd_2O_3 \cdot MoO_3$ with the structure closely related to $Eu_2O_3 \cdot MoO_3$ does not decompose below 1400°C. (auth)

27252 FLUORITE-RELATED PHASES IN THE SYSTEM CaO–HfO_2. Allpress, J. G.; Rossell, H. J.; Scott, H. G. (Univ. of Melbourne). Mater. Res. Bull.; 9: No. 4, 455-468(Apr 1974).

Three ordered fluorite-related phases which occur in the system CaO–HfO_2 are described. $Ca_2HF_7O_8$ (ϕ) is rhombohedral, with a = 9.527 Å, α = 38.80°. $Ca_2Hf_4O_9$ (ϕ_1) is monoclinic, with a = 17.698, b = 14.500, c = 12.021 Å, β = 119.47°. $Ca_8Hf_{19}O_{44}$ (ϕ_2) is rhombohedral, with a = 12.059 Å, α = 98.31°. (4 tables) (auth)

Metals and Alloys

Refer also to abstracts 27426, 28670, 28706, 28716–28722, 28916, 28917, 28919, 28924, and 28925.

27253 (CEA-CONF-2516) IN-SERVICE INSPECTION OF PRESSURIZED WATER REACTOR VESSELS EXAMINED IN THE INTERIOR BY ULTRASONICS. Saglio, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jun 1973. 15p. (In French). (CONF-731136-1). Dep. NTIS (U. S. Sales Only) $3.00.

From welding metallurgy meeting; Marseille, France (8 Nov 1973).

The techniques and the apparatus developed at the CEA for the internal in-service inspection of reactor vessels are described. The method for the interpretation of the results obtained from the ultrasonic inspection is discussed. The control of singular zones by ultrasonic techniques is outlined. (JSR)

27254 (COO-2305-1) ELECTRON-DISLOCATION INTERACTIONS AT LOW TEMPERATURES. Galligan, J. M. (Connecticut Univ., Storrs (USA). Inst. Materials Science). [nd] 4p. Dep. NTIS $3.00.

The following are reported: growth and doping of Pb crystals; growth and purification of Nb crystals; and a low-temperature tensile machine. No data are given. (DLC)

27255 INFLUENCE OF ANALYSIS, HEAT TREATMENT AND STRUCTURE ON SUSCEPTIBILITY TO INTERGRANULAR STRESS CORROSION CRACKING OF NICKEL–CHROMIUM–IRON ALLOYS (ALLOY 800 AND ALLOY 600). Carlen, J. C.; Blom, U. Technical Meeting No. 1/7. Basel; Nuclex (1972). 18p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Corrosion tests on a variant of Alloy 800 (Sanicro 30) in a modified Strauss solution have shown that the resistance to intergranular corrosion can be improved by a production sequence giving a small grain size and a high degree of stabilization. An investigation has also been performed in contaminated high-pressure water (100 ppM Cl^-/8 ppM O_2) on double U-bends of strip in Sanicro 30 and Alloy 600. This showed, for the inner U-bend in the crevice area, that the depth of intergranular attack depended on the type of low-temperature heat treatment. For Alloy 600 this was true also for the outside surface of the outer U-bend. The results from this investigation do not contradict the theory of a correlation between intergranular corrosion and intergranular stress corrosion cracking. (auth)

27256 PLUTONIUM-DOKUMENTATION. Transplutonium-elemente. Referate-zeitschrift. Band 8, Heft 1, Januar 1974. 254 referate (register-Nr. 1-464) 100 referate (register-Nr. 1T-100T). (Plutonium Documentation. Transplutonium Elements. Abstract Journal. Volume 8, No. 1, January 1974. 254 abstracts (Register No. 1-464) 100 abstracts (register No. 1T-100T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung mbH (1974). 141p. (In German and English).

27257 URANIUM: NEW DEVELOPMENT IS TARGETED AT THE FUTURE NUCLEAR GENERATING MARKET. Gordon, E. (Atomic Industrial Forum, Inc., NY). Eng. Mining J.; 175: No. 3, 156-160(Mar 1974).

This review covers U.S. industry statistics, exploration, mine-mill developments, market, embargo situation, demand, and supply.

International aspects, particularly in Australia, Canada, France, and South Africa, are reviewed as well as U.S. (9 tables) (DLC)

27258 THORIUM: BRIGHT FUTURE SEEN IN MARKET FOR REACTOR FUEL. Sondermayer, R. V. (Bureau of Mines, Washington, DC). Eng. Mining J.; 175: No. 3, 132-133(Mar 1974).

Thorium is derived principally from monazite, and the supply and processing of monazites in U.S. and abroad are discussed. The HTGR situation is described, with consideration being given to the symbiotic relation between FBR and HTGR. Prices and the thorium market are discussed. (DLC)

27259 MASS SPECTROMETRIC INVESTIGATION OF THE GAS RELEASE DURING THE ELECTRON BEAM FUSION OF MOLYBDENUM. Dzigoev, S. G.; Boyarshinov, V. A. Tsvetn. Metal.; No. 12, 54-57(Dec 1973). (In Russian).

It is shown that H_2 as a basic component of the gaseous phase (up to 80 vol. %) is the result of the decomposition of water vapor by the electron beam. Water vapor is formed basically as a result of the desorption of moisture from the sides of the furnace. The elimination of O_2 from Mo simultaneously with the formation of CO can result in the formation of CO_2. (tr-auth)

Corrosion and Erosion

27260 (AI-AEC-13122) CORROSION OF TYPE 304 STAINLESS STEEL IN SODIUM HYDROXIDE. Garr, K. R. (Atomics International Div., Canoga Park, Calif. (USA)). 1 Mar 1974. Contract AT(04-3)-824. 27p. AT.

Type 304 stainless steel samples were immersed in 50 wt % NaOH, for varying times, to determine the onset of discoloration. Prior to exposure to the caustic, the samples were given one of the following thermomechanical treatments: (1) solution annealed, (2) solution annealed and aged (sensitized), (3) solution annealed and 10% cold rolled, and (4) solution annealed and 55% cold rolled. Cold rolling inhibited the onset of discoloration, compared with the annealed condition; however, the degree of cold rolling did not have an effect. Also, there was no difference in the results of solution annealed and the sensitized samples. The times required for the onset of discoloration correlate very well with stress-corrosion cracking data. Agitation of the caustic solution decreases the time to discoloration, while reducing the concentration of sodium hydroxide increases the time. These results are applied to the problems of moist nitrogen cleaning of sodium from stainless steel components. (auth)

27261 (LA-UR-74-20) APPLICATION OF THICK FILM AND BULK COATING TECHNOLOGY TO THE SUBTERRENE PROGRAM. Stark, W. A. Jr.; Wallace, T. C.; Witteman, W.; Krupka, M. C.; David, W. R.; Radosevich, C. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 21p. (CONF-740103-2). Dep. NTIS $3.25.

From conference on structure-property relationships in thick film and bulk coatings; San Francisco, California, USA (28 Jan 1974).

The Subterrene is a rock-melting earth-penetration system representing a significant advancement in excavation technology. Temperatures of 1700-2000°K are involved, and heated refractory-metal or alloy probes are used. Corrosion problems are severe on the exterior surfaces of the refractory metals used; bulk coatings having the required properties would be extremely desirable provided they could be deposited upon a substrate as a tenacious coating. Within the Subterrene, pyrographite radiant heaters are operating at temperatures to 2450°K. Graphite receptors added to improve the radiant heat transfer react with the Mo and W penetrator bodies to form carbides. A 30 μm-thick CVD film of TaC may be applied to inhibit this reaction. The techniques of applying these films, their nature, and the results of their application, are discussed. The environment of an operating penetrator is described, and the requirements and properties of exterior coatings are outlined. (auth)

27262 (PWAC-381) LITHIUM CORROSION INVESTIGATION OF A HIGH POWER COLUMBIUM ALLOY SYSTEM. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 15 Feb 1963. Contract AT(30-1)-2789. 71p. Dep. NTIS $5.75.

Declassified 4 Sep 1973.

A 10,001 hour test was conducted to evaluate the corrosion behavior of a high power, forced circulation lithium corrosion loop constructed of Nb-1 Zr alloy. The loop was tested in a purified helium atmosphere with a heater exit temperature of 2000°F and a cooler exit temperature of 1600°F. The test was interrupted twice because of the malfunction of auxiliary equipment but neither shutdown required opening of the liquid metal circuit. Extensive post-test metallographic and chemical analyses of loop sections showed no significant corrosion or mass transfer. Slight solution attack was observed in the high temperature regions but no metallic mass transfer deposits were found anywhere in the loop. Considerable contamination of the Nb alloy was observed. Lithium seepage which occurred at four locations, including two weld joints, in the heater section, had no effect on the loop operating conditions. The Nb alloys was contaminated with oxygen in the seepage sections and intergranular lithium penetration was noted in these contaminated regions. Other sections of the loop, contaminated to a lesser degree showed no significant lithium attack. Posttest examination results clearly indicated that contamination occurred during test operation, probably from impurities in the helium atmosphere. There was some evidence, also, that the weld joints were contaminated prior to test, probably during the welding or annealing operation. The impurity concentrations in the helium cover gas were at or less than the limits of detection of the available instruments during the major part of the test period. (auth)

27263 (SLA-73-5798) CRYSTALLOGRAPHIC DISTRIBUTION OF HYDROGEN ON CATALYTIC SURFACES. Panitz, J. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 11p. (CONF-740306-5). Dep. NTIS $3.00.

From hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

Crystallographic distribution data for hydrogen on tungsten and iridium are presented using field desorption spectrometry. Selective adsorption was observed on the [111] zone of tungsten and in the vicinity of the 321 plane of iridium. It is suggested that such selectivity may be due to hydrogen permeation of interstitial lattice spaces. For iridium, highly localized adsorption sites randomly distributed on the surface appear to be associated with impurity atoms. (9 figures) (auth)

27264 ENTRAINMENT OF SODIUM IMPURITIES WITH ITS BURNING PRODUCTS. Chechetkin, Yu. V.; Kobzar, I. G.; Poznyak, G. I. At. Energ. (USSR); 35: No. 6, 401-404(Dec 1973). (In Russian).

An experimental study of impurities entrainment during sodium burning in natural atmosphere was conducted. It is shown that in the absence of means of burning suppression the entrainment of sodium in the form of aerosols does not exceed 14% of the oxidized mass of sodium. Burning products entrain impurities of the initial sodium to the atmosphere, their quantity in aerosols ranging from 3 to 56% of the total in the initial sodium. Data were obtained on the spatial distribution of the deposited sodium and impurities burning products as a function of the total quantity of sodium oxides released to the atmosphere. The results can be used in the analysis of the consequences of accidental leakage of fast reactor sodium coolant, in the development of measures to eliminate such leakages and in designing gas discharge cleaning systems. (auth)

27265 DISSOLUTION OF RADIOACTIVE CARBON STEEL IN SULFURIC ACID WITH THE ADDITION OF A NUMBER OF INHIBITORS. Balezin, S. A.; Laptev, N. Ya. (Moscow State Pedagogical Inst.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 12, 1915-1916(1973). (In Russian).

Steel disks (wt = 6 g) were irradiated at a thermal neutron flux of 1.2×10^{13} n cm^{-2} sec^{-1} for a period of 60 days. The specific activity of the samples was 3.6 mCi/g. The control samples were not irradiated, but kept in sealed ampules at room temperature. Corrosion tests were undertaken in 5 N H_2SO_4 with and without the addition of an inhibitor (0.05% catapine A, 0.05% potassium iodide, or 0.5% formaldehyde). Without an inhibitor the corrosion rate in g m^{-2} h^{-1} was 2.50, 1.88 and 1.67 for radioactive samples after 4, 24, and 48 h of corrosion testing, while the corresponding values were 2.87, 2.82 and 2.79 g m^{-2} h^{-1} for the inactive samples. With catapin A the corresponding values were 0.25, 0.14 and 0.12 for the radioactive samples, and 0.22, 0.17, and 0.16 for the inactive control samples of 4, 24, and 48 hours respectively. With 0.05% potassium iodide inhibitor the corrosion rates were 0.65, 0.22 and 0.16 g m^{-2} h^{-1} for the radioactive samples, and 0.56, 0.22 and 0.18 g m^{-2} h^{-1} for the inactive controls after 4, 24, and 48 hours respectively. With 0.5% formaldehyde inhibitor the corrosion rates were 1.69, 0.64 and 0.39 for the radioactive samples, and 1.76, 0.63 and 0.45 g m^{-2} h^{-1} for the inactive controls after 4, 24, and 48 hours respectively. The rate of corrosion of the radioactive steel with and without an inhibitor decreases significantly with time. (SJR)

27266 TRENDS IN THE ANODIC OXIDATION OF VANADIUM-GALLIUM ALLOYS IN KOH SOLUTION. Nikitin, E. V.; Dezider'eva, L. G. (Kazan State Univ.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 12, 1868-1871(1973). (In Russian).

Electrochemical oxidation has been proposed as a method of separating the superconducting phases of vanadium alloys. From a theoretical point of view the vanadium alloys should retain the properties of the transition metal (vanadium), as long as the d-

electron vacancies are not filled. A plot of current density as a function of polarization potential shows several reaction stages for vanadium metal. First there is a cathodic evolution of hydrogen. Then there is a stage of primary passivation due to incipient formation of an oxide film (probably V_2O_3). The third stage is an active state where the electrode dissolves and there are $HV_2O_5^-$ ions in the solution. The fourth stage is a secondary passive state of the vanadium electrode associated with the presence of an amorphous oxide film $VO(OH)_2$. In the fifth state a sharp increase in current density is observed associated with the formation of a film of difficulty soluble KVO_3. Finally a passive film of amorphous V_2O_5 is formed. With vanadium–gallium alloys ($V_{3.35}Ga$, $V_{3.35}Ga$ and $V_{4.52}Ga$) in 0.1 N KOH a substantial difference from the behavior of pure vanadium is that the V–Ga alloys remain in a state of secondary passivation up to a potential of +5.0 volts, while pure vanadium activates at a voltage of +0.9 volts, after which it enters a third passive state. (SJR).

27267 DIFFUSION IN A FINITE SYSTEM WITH A MOVING BOUNDARY. Pawel, R. E. (Oak Ridge National Lab., TN). J. Nucl. Mater.; 49: No. 3, 281-290(Jan 1974).

Important characteristics of many oxidation reactions are associated with the infusion of oxygen into the metal in advance of the oxide–metal interface. The calculation of the resulting oxygen profiles generally involves the solution to the diffusion equation for a finite system with a moving boundary. While it was possible to obtain at least approximate analytical solutions in this case for the simplest initial and boundary conditions, it is apparent that these solutions are not easily applicable to many reactions of interest. The approximate analytical solutions to the finite-geometry moving-boundary problem are presented along with results from these solutions and those obtained by a finite-difference method based on a simple model of the system. The excellent agreement in the computed profiles for the isothermal parabolic reactions is regarded as encouraging evidence that both methods are reasonably accurate and further suggests that the latter method would be an especially useful approach in examining diffusion behavior under more complicated conditions. (auth)

27268 OXYGEN EFFECTS ON THE CORROSION OF NIOBIUM AND TANTALUM BY LIQUID LITHIUM. Klueh, R. L. (Oak Ridge National Lab., TN). Met. Trans.; 5: No. 4, 875-879(Apr 1974).

The effect of oxygen on the corrosion at 600°C was studied with static capsules. An increase in the oxygen concentration of Li from 100 to 2000 ppM had no measurable effect on the dissolution of either refractory metal. Exposure to Li reduced the O content of Nb and Ta to ≤ 20 ppM regardless of the O concentration of the Li, results that agree with thermodynamic calculations. When the initial O concentration of Nb and Ta exceeded a threshold level, Li (with no O added) penetrated the refractory metal. Penetration resulted from the formation of a ternary oxide on grain boundaries or preferred crystallographic planes and proceeded by a wedging mechanism, which is caused by stresses generated by the corrosion product. Penetration was along grain boundaries at low O concentrations, the attack depth and number of affected boundaries increasing with increasing O concentration. At higher O concentrations, transgranular attack also occurred. The threshold O concentrations for attack were 400 and 100 ppM for Nb and Ta, respectively. (auth)

27269 OXIDATION BEHAVIOR OF AN IRON–CHROMIUM ALLOY CONTAINING YTTRIUM OR RARE EARTH ELEMENTS BETWEEN 900° AND 1200°C. Nakamura, Y. (Defense Academy, Yokosuka, Japan). Met. Trans.; 5: No. 4, 909-913(Apr 1974).

The oxidation behavior of Fe–15 wt% Cr alloys, some containing small additions of yttrium or rare earth elements, was observed using a TG and an EPMA method at temperatures between 900 and 1200°C. Yttrium or rare earth element additions result in a rapid initial oxidation rate, but decrease the total weight gain at the final time of exposure. The line trace obtained indicates an increased segregation of Cr in the inner oxide layer of the alloy containing yttrium or rare earth elements and also shows that enriched concentrations of yttrium or lanthanum are detected within the chromium oxides which exist near the oxide scale/alloy matrix interface. Yttrium or rare earth element oxides serve as the sites for the protective chromium oxide scales. (8 figures) (auth)

27270 ELECTRIC CONDUCTIVITY OF SOLID SOLUTIONS ZrO_2–Y_2O_3, ZrO_2–Yb_2O_3, AND ZrO_2–Sc_2O_3. Pal'guev, S. F.; Gorelov, V. P.; Volchenkova, Z. S. Tr. Inst. Elektrokhim., Ural. Nauch. Tsentr. Akad. Nauk SSSR; No. 20, 140-144(1973). (In Russian).

The electrical conductivity of the solid solutions $ZrO_2 + Y_2O_3$, $ZrO_2 + Yb_2O_3$, and $ZrO_2 + Sc_2O_3$ containing 6.0-16.7 mole % Me_2O_3 prepared by coprecipitation with geometrical dimensions ensuring a significant decrease in the effects of the electrodes was studied at temperatures from 750 to 1200°C. The results of the measurements were observed as a function of the radius of the cation Me^{3+}. The nature of the temperature dependence of the electrical conductivity of the samples is explained by the specific interaction of defects in the lattice. (tr-auth)

27271 REACTION OF METALLIC ZIRCONIUM WITH MOLTEN ALKALI METAL CHLORIDES CONTAINING THEIR HYDROXIDES. Ozeryanaya, I. N.; Zauzolkov, I. V.; Shamanova, N. D.; Smirnov, M. V. Tr. Inst. Elektrokhim., Ural. Nauch. Tsentr. Akad. Nauk SSSR; No. 20, 90-94(1973). (In Russian).

The effect of potassium and sodium hydroxides on the corrosion of zirconium in their molten chlorides was studied. It was shown that corrosion of zirconium is due to the action of the hydroxyl ions. The rate of the process is limited by diffusion of ions in the layer of solid corrosion products. (tr-auth)

27272 EFFECT OF CONTAINER MATERIAL ON REACTION OF ZIRCONIUM WITH MOLTEN STRONTIUM CHLORIDE. Ozeryanaya, I. N.; Tkhai, V.; Smirnov, M. V.; Burakova, E. A. Tr. Inst. Elektrokhim., Ural. Nauch. Tsentr. Akad. Nauk SSSR; No. 20, 86-89(1973). (In Russian).

It was shown that, in molten salt, the corrosion of metals occurs not only by reaction with ions of the salt but is complicated by participation of the container material not in direct contact with a corroding sample. Of a series of materials tested (quartz, alundum, zircon, beryllium oxide, carbon glass, molybdenum), alundum was the most resistant to the action of molten strontium chloride. (tr-auth)

27273 MECHANISM OF CORROSION OF Cr AND ITS ALLOYS WITH RARE EARTH METALS IN HCl SOLUTIONS. Tavadze, F. N.; Rudoi, A. P.; Mikadze, O. I.; Mandzhgaladze, S. N. (Inst. of Metal Physics, Kiev). Metallofizika; No. 45, 21-27(1973). (In Russian).

A study was made of the corrosion resistance of Cr and its alloys with the rare earth metals (Y, Ce, La, N, B) kept in 10, 30, and 50% HCl for 1 month. It was shown that the kinetics of the destruction of the samples was determined by the distribution of the phases in both the cast and the deformed alloys. Rare earth metals present in amounts greater than the solubility limits impaired the corrosion resistance of the alloys in the initial period of active solution of the samples. (tr-auth)

Preparation and Fabrication

Refer also to abstracts 26750, 27206, 28931, and 28943.

27274 (AD-769937) THERMOMECHANICAL PROCESSING BETA TITANIUM. Final Report, 11 May 1972–10 August 1973. Avery, D. H.; Polan, N. W. (Brown Univ., Providence, R.I. (USA)). Sep 1973. Contract DAAG46-72-C-0165. 38p. (AMMRC-CTR-73-30). NTIS $3.00.

The response of the beta alloy TS6 (Ti : 10 Cr, 7 V, 3.5 Mo, 3 Al), to a wide variety of thermomechanical treatments was investigated, including effects of cold work on polygonized structures, cold-reduction temperature, and multi-stage aging. Combinations of strength and ductility can be manipulated within a wide range by varying the amount of cold work and the aging treatment. Mechanical properties are strongly dependent upon the mode of deformation during cold working and slight variations in alloy chemistry. Stress corrosion tests indicate superior performance of TS6 compared with similarly treated beta-120VCA. Scale-up of ingot melting and processing techniques was accomplished. Ingots of TS6 weighing twenty-eight pounds were prepared using a master-alloy technique. Hot extrusion at 1800°F yielded two-inch diameter rod which has been successfully cold press-swaged 20% and cold rolled 90%. Compared with previous one-pound heats of TS6, this material overages earlier, at somewhat lower hardness levels, and with more rapid kinetics. (GRA)

27275 (CONF-730726-13) WELDING AUSTENITIC STEEL CLADS FOR FAST REACTOR FUEL PINS. Papeleux, P.; Flipot, A. J.; Lafontaine, I. (Societe Belge pour l'Industrie Nucleaire, Brussels; Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1973. 24p. (SM-173-7-47). Dep. NTIS $3.25.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

Developmental programs aimed at fabrication of stainless steel-clad PuO_2 fuel pins are described. Information and data are included on welding fast reactor fuel cans, methods of reducing the incidence of weld cracking, effects of weld stresses, and fuel plug design. (JRD)

27276 (JPRS-61321) PLASMA PROCESSES IN METALLURGY. Paton, B. E. (ed.). 26 Feb 1974. Translated from

Plazmennyye Protsessy v Metallurgii i Tekhnologii Neorganicheskikh Materialov, 1973, Nauka, Moscow. 189p. NTIS.

An examination of the state and development of the theory of generation and application of low temperature plasma including plasma-arc heating is described. Articles are included on plasma-arc melting and heating, electrodeposited coatings, plasma spraying, plasma cutting, plasma-arc production of monocrystals, spray coating, metal reducing processes, and preparation of refractory compounds. (JRD)

27277 PRODUCTION OF A NICKEL–TIN–TUNGSTEN ALLOY BY CHEMICAL REDUCTION WITH HYDRAZINE. Izmanlov, A. V.; Sobolev, E. A.; Shilova, G. Z. (Moscow Technological Inst. of the Meat and Dairy Industry). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 12, 1917-1918(1973). (In Russian).

The following solution composition was found to be optimal in precipitating the ternary Ni–Sn–W alloy as a hard covering on a metal: nickel chloride–30 g/l, ethylenediamine (100%)–48 ml/l, stannous chloride–2 g/l, sodium tungstate–20 g/l, sodium citrate–60 g/l, sodium hydroxide–80 g/l, and hydrazine hydrate–5 ml/l. The temperature of the solution is 95 to 98°C. The rate of formation of the ternary alloy is 18 to 20 microns/h. The precipitate has a hardness of 250 to 350 kg/mm^2. Tungsten will not precipitate from the solution unless sodium citrate is present as a complexing agent. The precipitate contains 11% tin and 10% tungsten. (SJR)

27278 DRAWING OF WIRES USING ULTRASONICS. Severdenko, V. P.; Zhilkin, V. Z. (Krasnoyarsk Inst. of Nonferrous Metals, USSR). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Tekh. Navuk; No. 4, 12-16(1973). (In Russian).

The results of the drawing of wires from Ti, steel, Mo, Ni alloy, and constantan with application to the filament of ultrasonic vibrations are reported. The dependence of the drawing force on the intensity of the ultrasonic vibrations is established for different drawing conditions. The effect of the ultrasonics on the properties of the wire is shown. (tr-auth)

27279 NUCLEATION OF PLATINUM AND IRIDIUM MONOLAYER GROWTH ON (110) TUNGSTEN SURFACES. Tice, D. R.; Basset, D. W. (Imperial Coll. of Science and Tech., London). Thin Solid Films; 20: No. 2, S37-S40(Feb 1974).

Two modes of Pt and Ir monolayer nucleation are described that are different from those usually envisaged for island growth. Field ion microscopic images are included showing stages in monolayer growth. (JRD)

27280 BORON NITRIOLE AND BORON PRODUCTION IN A NITROGEN PLASMA JET. Russo, G.; Diana, M.; Beretta, F. (Univ., Naples). Combust. Sci. Technol.; 5: No. 5, 237-242(Jul 1972).

The preliminary results obtained by feeding boron trichloride in a nitrogen plasma jet downstream the anode are given. Maximum BCl_3 conversions of 15% have been obtained for 20 kW and BCl_3 flow rates about 2 g/min by quenching the reacting mixture with a water-cooled rotating cylinder. BCl_3 conversion is apparently irrespective of the nitrogen flow-rate and drops from 15% to 3% on increasing the BCl_3 flow-rate. Without the use of the quenching devices BCl_3 was not converted at all. The solid product contains boron and boron nitride and about half the total boron is present as boron nitride. The results show that experimental conversions are higher than those predicted from thermodynamic equilibrium of the system BCl_3–N_2. (auth)

27281 EFFECT OF INITIAL ORIENTATION OF SINGLE-CRYSTAL TUNGSTEN ON ITS DEFORMATION DURING HIGH-TEMPERATURE ROLLING IN VACUUM. Krupin, A. V.; Linetskii, B. L.; Gurevich, Ya. B.; Mikhridinov, R. M.; Papchenko, V. I. (Moscow Steel and Alloy Inst.). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 160-162(1973). (In Russian).

Single-crystal tungsten was rolled in a vacuum of 3 to 5×10^{-5} mm Hg std at temperatures of 800, 1000, 1200, and 1400°C at a rate of 0.1 m/s. Steel rollers were used at 800 to 1200°C and alloy rollers at 1400°C so that no sticking took place during rolling. Results showed that at all temperatures, the single crystals {001}⟨110⟩{001}⟨110⟩ and {111}⟨110⟩ even at degrees of deformation of 70 to 75% per pass are deformed without any sign of breakdown. At all rolling temperatures the metal becomes cold-worked, as shown by increase in Vickers hardness; the degree of coldworking decreases with temperature. The coldworking and also the deformability do not depend on initial orientation. Samples were rolled to a final thickness of 1 mm by various methods. No breakdown could be observed. Thus, high-temperature rolling in vacuum is an effective method of producing high-quality articles from single-crystal refractory metals. (SJR)

27282 PROCESSING OF TUNGSTEN–MOLYBDENUM CONTAINING WASTES FROM THE MANUFACTURE OF MV-50 ALLOY. Kalashnik, A. N.; Reznyakov, A. A.; Mirkin, L. A.; Ogorodnik, N. V.; Kol'tsova, V. Ya. Tsvetn. Metal.; No. 12, 57-59(Dec 1973). (In Russian).

The optimum regime for the primary processing of wastes containing W and Mo is established. The waste is annealed in an air current (10 cm/s) for 2 h. During this time, 90% of the Mo is sublimated. (tr-auth)

27283 USE OF PLASMA HEATING FOR THE GROWTH OF REFRACTORY METAL MONOCRYSTALS. Savitskii, E. M.; Burkhanov, G. S.; Shnyrev, G. D.; Doron'kin, E. D.; Sergeev, N. N. Tsvetn. Metal.; No. 12, 40-41(Dec 1973). (In Russian).

A method is described for the preparation of coarse monocrystals of W and Mo by use of plasma heating. The advantages of the new method and quality of the crystals grown are examined. (tr-auth)

27284 PRODUCTION OF HARD Zr BASE ALLOYS CONTAINING Ru AND THEIR MECHANICAL PROPERTIES. Kimura, K.; Uehara, S.; Watanabe, R.; Sasaki, Y.; Tsuya, K. (to National Research Inst. for Metals). Japanese Patent 1973,27173. 12 Apr 1968. 3p. (In Japanese).

Zirconium and zirconium-base alloys containing 0.1 to 2% ruthenium with strong age hardness are produced. The process for manufacturing such alloys comprises the steps of treating the alloys within the range of beta phase to form a solid solution, quenching the alloys, and thereafter aging the alloys at a temperature of 300 to 500°C. The alloys improve their hardness without damaging workability, small cross section for neutrons, and corrosion resistance equal to Zircaloy-2, and are suitable for compact construction. In an example, 3% of Zr–11% Ru mother alloy and 2.5% of Nb are added to Zr, melted in an arc furnace and then with electron beams, and thereafter hot-rolled at 850°C, then cooled to form a plate 0.8 mm thick of Zr–2.5%Nb–0.3%Ru with Vickers hardness 190. These alloys are annealed at 500, 450, and 400°C for 10,000 minutes. (JA)

Properties, Structure, and Phase Studies

Refer also to abstracts 27200, 27208, 28920, 28921, 28923, 28927, 28929, 28938, and 28945.

27285 (AD-767064-9-GA) PART-THROUGH-CRACK BEHAVIOR IN THREE THICKNESSES OF MILL-ANNEALED Ti–6Al–4V PLATE. Final Report. Feddersen, C. E.; Porfilio, T. L.; Rice, R. C.; Hyler, W. S. (Battelle Columbus Labs., Ohio (USA)). 31 Dec 1972. Contract N61169-72-C-0036. 94p. NTIS $3.75.

Part-through crack behavior has been evaluated in ¼, ½, and 1-in. thicknesses of mill-annealed Ti–6Al–4V plate. Constant-amplitude fatigue-crack propagation, overload-crack retardation, near-fracture crack extension, and critical fracture or residual strength were the four aspects of crack behavior considered. The near-fracture crack extension studies demonstrate that over the finite range of thickness considered, the region of critical crack instability occurs at the extremes of the crack length dimension, rather than at the depth as postulated by classical elastic concepts. This supports the representation of fracture data by a semiempirical approach outlined. In general, it appeared that toughness can be characterized by simple formulations of the stress-intensity factor, excluding the back surface correction. However, the back surface correction was a necessary transformation to achieve a smooth transition of fatigue-crack-propagation behavior during breakthrough of the back surface. (GRA)

27286 (AD-767780-0-GA) DEVELOPMENT OF ULTRAHIGH-STRENGTH, DUCTILE TITANIUM ALLOYS BY THERMOMECHANICAL PROCESSING AND TRANSFORMATION-INDUCED PLASTICITY. Final Report, 1 March 1972–31 May 1973. Jones, R. L. (Stanford Research Inst., Menlo Park, Calif. (USA)). Jun 1973. Contract N00019-72-0201. 57p. NTIS $3.50.

Binary alloys of titanium with the beta-eutectoid solutes Fe, Mn, and Cr were investigated. An investigation was also made of the deformation-induced transformation behavior and mechanical properties of alloys based on Transage 129 (Ti–2Al–11V–2Sn–11Zr). Marked transformation-induced plasticity (TRIP) behavior was observed for the experimental alloys in a beta-annealed condition, especially when the V:Al content ratio was reduced below 5.5. When the alloys were aged to increase the yield strength, the TRIP behavior disappeared, although deformation-induced transformation still occurred in some instances. The reasons for this behavior are discussed, and it is concluded that a high yield strength and TRIP behavior are mutually exclusive in these alloys, since both depend on the same strengthening mechanism. (GRA)

27287 (AD-769821) SECOND REPORT ON DEFORMATION MECHANISM MAPS. Final Report. Frost, H. J.; Ashby, M. F.

(Harvard Univ., Cambridge, Mass. (USA). Div. of Engineering and Applied Physics). Aug 1973. Contract N00014-67-A-0298-0020. 113p. NTIS $7.75.

Deformation mechanism diagrams show the fields of stress and temperature in which a given mechanism is dominant and the strain rate that it yields. Detailed maps are presented for five pure fcc metals (Ni, Cu, Ag, Al, Pb), six pure bcc metals (V, Cr, Nb, Mo, Ta, W) and a recrystallized Ni–1 vol% ThO_2 alloy, which are based on direct comparison to available experimental data. The various deformation mechanisms are discussed, with refinements of their rate equations. Various applications of the diagrams are illustrated. They provide a convenient means for the normalized comparison of the behavior of different metals. They also demonstrate the effects of various changes in materials in a manner useful for qualitative engineering design. (auth)

27288 (AD-770235) EFFECTS OF HYDROGEN ON THE MECHANICAL PROPERTIES AND FRACTURE OF Zr AND REFRACTORY METALS. Birnbaum, H. K.; Grossbeck, M.; Gahr, S. (Illinois Univ., Urbana (USA)). Nov 1973. Contract N00014-67-A-0305-0020. 27p. NTIS $3.00.

The effect is reviewed with particular attention to the effects on fracture and ductility. The various mechanisms proposed for the hydrogen embrittlement of these metals are reviewed. Both the effects of hydrogen in solution and in the surrounding gas phase is considered. New results on the embrittlement of Nb and Nb–N alloys are presented and discussed relative to the generic embrittlement phenomena in these metals. The relation of the crack propagation mechanism to stress and temperature-induced phase changes is discussed and a model of hydrogen embrittlement is put forth. (GRA)

27289 (AD-770343) MECHANICAL PROPERTIES AND HIGH-TEMPERATURE STABILITY OF Ti–Mo–Al ALLOYS. Technical Report, 1 April 1972–30 June 1973. Hamajima, T.; Hida, M.; Weissmann, S. (Rutgers–the State Univ., New Brunswick, N. J. (USA). Materials Research Lab.). Sep 1973. Contract F33615-72-C-1566. 23p. (AFML-TR-73-226). NTIS $2.75.

The phase diagram of the isopleth section of the Ti–7 at.% Mo–Al system was improved and expanded to include alloys up to 25 at.% Al. The mechanical and thermal stability of alloys aged in the two-phase region, $\beta + Ti_3Al$, and in the three-phase region, $\beta + \alpha + Ti_3Al$, were correlated to the microstructures. Considerable increases in high-temperature strength and ductility, as well as high-temperature stability, were achieved in a Ti–7 at.% Mo–16 at.% Al alloy by step-aging. (GRA)

27290 (AD-770980) FATIGUE CRACK GROWTH IN Ti–6Al–4V FROM THRESHOLD TO UNSTABLE FRACTURE. Amateau, M. F.; Hanna, W. D.; Kendall, E. G. (Aerospace Corp., El Segundo, Calif. (USA)). 30 Nov 1973. Contract F04701-73-C-0074. 80p. (SAMSO-TR-73-368). NTIS $3.75.

The fatigue crack growth of Ti–6Al–4V in the diffusion-bond-annealed condition was examined in the range of growth rates from 10^{-12} to 10^{-4} m/cycle with the use of compact tension and part-through-crack specimens. Effects of cyclic frequency and maximum stress were investigated. Fractured surfaces were examined by scanning electron microscopy over the entire range of crack growth. The fatigue data were fit empirically to a number of crack propagation laws, none of which was able to predict the entire range of crack growth from threshold to unstable fracture. When the fatigue crack growth rates were compared with those of Ti–6Al–4V of other microstructures, it was found that the diffusion-bond-annealed was among the most fatigue-crack-resistant of any microstructure examined. (auth)

27291 (AWRE-O-2-74) DENSITY VARIATIONS IN POROUS HOT PRESSINGS OF HIGH DIAMETER TO LENGTH RATIO. Baldwin, M. P. (UKAEA Weapons Group, Aldermaston, Atomic Weapons Research Establishment). Jan 1974. 17p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

Results are presented of the density profile measurements through the thickness of porous beryllium compacts hot pressed by a "limited ram travel" method to overall densities in the range 86 to 96% theoretical. The geometries investigated were 14 in. diameter 0.9 in. thick and 16 in. diameter 1.8 in. thick. It is shown that both compact geometries consist of zones of high density variation near the top and bottom surfaces, together with a middle zone of relatively uniform density. The high density variation zones were attributed to frictional effects and it was concluded that to achieve a uniform density product the pressing geometry had to allow the friction affected material to be discarded. (auth)

27292 (CEA-CONF-2518) IMPROVEMENTS IN ULTRASONIC TESTING METHODS OF WELDS, SPECIALLY IN THE PRESENCE OF AUSTENITIC STEEL CLADDING. Saglio, R.; Prot, A. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 19 Dec 1972. 40p. (CONF-731003-5). Dep. NTIS (U. S. Sales Only) $4.00.

From second international congress for pressure vessel and piping technology; San Antonio, Texas, USA (1 Oct 1973).

Studies were conducted to develop a constant time ultrasonic method of testing stainless steel clad components. In testing thick-plate welds, it is necessary, in order to scan the whole wall thickness, to move the transducer back and forth. To record the defect signal a gate is needed that is fixed, but large enough to take into account all the signals corresponding to different time intervals, or a narrow one, designed to follow the transducer's position. In the case of immersion testing the transducer is moved along such path, as to keep constant the total time of travel of the ultrasonic waves in the coupling medium and in the metal. Several advantages of this method are described. (JRD)

27293 (CEA-CONF-2530) EFFECT OF THE ANNEALING TEMPERATURE ON THE CREEP STRENGTH OF COLD WORKED ZIRCALOY-4 CLADDING. Frenkel, J. M.; Weisz, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Recherches Metallurgiques Appliquees). 1973. 6p. (CONF-730822-3). Dep. NTIS (U. S. Sales Only) $3.00.

From symposium on zirconium in nuclear application; Portland, Oregon, USA (21 Aug 1973).

Transverse creep strength of Zircaloy-4 tubing annealed at 440 to 650°C was evaluated by internal pressure tests, short-time control tests at 400°C, and long-time tests (both out-pile or in-pile) between 330 to 400°C. For low and intermediate stresses (lower than 133 MPa), transverse creep strength increases if the annealing temperature is increased from 440 to 650°C. In-pile tests confirm this trend. The effect of the annealing temperature on the yield and creep anisotropy of the tubes was evaluated at 400°C. It is concluded that the beneficial effect of a recrystallization treatment on the creep strength of zircaloy 4 tubes is related to an effect of texture variation. (5 figures) (auth)

27294 (CONF-701075-1) EFFECTS OF LOW CARBON CONTENTS AND EXPOSURES TO LIQUID SODIUM ON ELEVATED-TEMPERATURE BEHAVIOR OF 2¼ PERCENT Cr–1 PERCENT Mo STEEL. Sponseller, D. L.; Semchyshen, M.; Grobner, P. J. (Climax Molybdenum Co., New York (USA)). 1970. 40p.

From symposium on metal forming and interrelation between theory and practice; Cleveland, Ohio, USA (21 Oct 1970).

Elevated-temperature strength of 2¼% Cr–1% Mo steel with carbon contents in the range 0.01 to 0.04% has been measured, because of the potential use of this Cr–Mo steel in liquid-metal fast breeder reactors. The low carbon contents were achieved either by melting, or by the decarburizing effect of liquid sodium. Reducing carbon content from 0.08 to 0.15% C to 0.10% has little influence on elevated-temperature tensile strength of annealed material. Creep-rupture strength of the annealed material decreases as the carbon content is lowered to 0.01%; the decrease is more significant below 0.04% C. A rather dense dispersion of fine Mo_2C carbides develops at the 0.04% carbon level, but not at the 0.01% C level. The combined effects of carbide coarsening and decarburization during a 27,000 hour exposure of fine-grained 2¼% Cr–1% Mo commercial steel to liquid sodium at 1100 to 1200°F cause substantial reductions in elevated-temperature tensile strength, and moderate reductions in rupture strength. (auth)

27295 (CONF-740104-5) FORMATION AND USE OF OXIDE FILMS TO IMPEDE OUTGASSING OF METALS. Strehlow, R. A.; Savage, H. C. (Oak Ridge National Lab., Tenn. (USA)). 1973. 12p. Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

Phenomena associated with the outgassing of metals are generally interpreted using models based either on desorption of compounds from the surface or on diffusion of dissolved gases from the interior of the metal. It is generally recognized that surface oxide films can serve to decrease outgassing rates of metals. However, the processes associated with the outgassing of oxidized or oxide-coated metals are not well understood. Outgassing of oxidized metals is considered in light of the results of recent studies of hydrogen permeation through metals with well characterized oxide films. The chemical stabilities of the oxides as well as the physical imperfections of the film are considered. A model is suggested for the expected outgassing behavior of oxidized steels at intermediate temperatures, which are of interest in the design of controlled thermonuclear research

experiments and reactors. The role of impurities and the usefulness of specialized oxidation treatments are discussed. (auth)

27296 (COO-2166-12) LOW-TEMPERATURE BRITTLENESS. Stein, D. F. (Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering). 1973. 33p. (CONF-730806-5). Dep. NTIS $3.75.

From 3rd international conference on the strength of metals and alloys; Cambridge, UK (20 Aug 1973).

Low temperature brittleness of materials is examined. Understanding the basic chemical forces that hold materials together as represented by potential functions still limits the understanding of the true fracture stress, inherent lattice resistance to dislocation mobility, and the origin of crystal types. Therefore, basic theoretical advancement on the role of alloying and crystal types on brittle fracture is limited by advances in theoretical and experimental work in the area of potential functions. The understanding of the role of dislocation mobility in determining fracture behavior has advanced well. The role of dislocation motion in energy adsorption at the crack tip and in defining the cleavage plane is a tractable problem, given the dislocation dynamics parameters for the given material. Calculations to estimate the "drag stress" due to inherent lattice resistance and defect interactions are well developed and useful. Limitations, however, exist in the understanding of the rate of dislocation multiplication and in the sensitivity of dislocation motion to stress and since these appear to be important in determining the fracture behavior, full understanding will await determination of the origin of these parameters. Understanding of certain aspects of grain boundary fracture of materials is proceeding rapidly, primarily because of the development of new analytical tools for determining grain boundary chemistry. It is now possible to determine the chemistry within an atom layer of the grain boundary so the chemical composition of the fracture path can be accurately determined. However, the basic problem of predicting the fracture behavior is the same as that for cleavage and therefore the limitations previously described apply. Data are given for the metals Mo, V, Ta, Nb, and W. (auth)

27297 (COO-2354-1) CLUSTER CARBURIZING. Progress Report, June 1, 1973–May 31, 1974. Morral, J. E. (Connecticut Univ., Storrs (USA)). 1974. Contract AT(11-1)-2354. 15p. Dep. NTIS $4.00.

Tantalum alloys containing 27 at.% Hf and 1 at.% C + O were age-hardened in a carbon-free environment as a standard for comparison with cluster-carburized alloys. After aging for one hour, the alloys showed two hardness peaks at 600 and 960°C. From a solutionized hardness of 350 VHN, the hardness increased to 700 VHN at the low-temperature peak and to 500 VHN at the high-temperature peak. A cellular reaction was observed to occur when annealing for one hour between 943 and 1078°C. An equation is given which predicts the volume fraction of cellular precipitate as a function of time and temperature. (6 figures) (DLC)

27298 (COO-3459-4) DEFORMATION AND FRACTURE OF HYDRIDED HAFNIUM. Straw, R. L.; Stoloff, N. S. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). [nd]. 17p. (CONF-730992-1). Dep. NTIS $3.00.

From conference on hydrogen in metals; Seven Springs, PA (23 Sep 1973).

The influence of hydrides on both strength and fracture behavior of hafnium at low temperatures was studied with particular emphasis upon fracture modes. It was found that hydrogen in the form of fine precipitates oriented parallel to the basal plane increases the yield stress of hafnium until a stress is reached at which bypass of the hydrides by cross slip occurs. The uniform elongation and reduction in area of hafnium are reduced by basal hydrides. Basal cleavage occurs in unhydrided hafnium tested at 4.2°K and 77°K. Hydrogen in quantities less than 6 at. % increases the tendency for cleavage; 6 at. % hydrogen produces intergranular failure. The fracture behavior of hafnium and hafnium–hydrogen alloys is consistent with a modified Cottrell–Petch analysis of brittle fracture. (auth)

27299 (EUR-5025(Pt.2)) DEVELOPMENT AND STUDY OF FOUR NEW ZIRCONIUM ALLOYS. Part 2. Tables and Figures. Boerman, D. J.; Bonnet, P.; Imarisio, G. C.; Barigozzi, F.; Brera, C.; Quinto, A. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). 1973. 41p. (In Italian). Dep. NTIS (U.S. Sales Only) $5.25.

The alloys are Zr–1.44 Cr; Zr–0.84 Cu–0.37 Fe; Zr–1.26 Cu–0.37 Fe; and Zr–0.75 V–0.76 Fe. The properties tabulated include hardness, elongation, other tensile properties, and slip velocity. The materials were in the hot-rolled, cold-rolled, annealed, and oxidized/corroded conditions, and hydridation was also studied. Effects of terphenyl exposure were studied, and microstructures and pole figures are given. (DLC)

27300 (KFK-1882) STRESS-RUPTURE BEHAVIOR OF TUBES OF AUSTENITIC STEELS AND NICKEL-BASE ALLOYS UNDER INTERNAL PRESSURE. Polifka, F.; Schaefer, L.; Kempe, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Nov 1973. 95p. (In German). Dep. NTIS (U. S. Sales Only) $6.75.

The results of stress-rupture tests on tubes of seven austenitic stainless steels and five Ni-based alloys, part of which had undergone different thermo-mechanical treatments, are reported. The tubes were loaded by internal gas pressure causing a biaxial stress state. The test temperatures were 600 to 750°C. The thin-walled seamless precision tubes were carefully checked before in order to detect defects and dimensional variations. The outer diameter was about 6 mm. Plots of stress-rupture curves, of master curves according to Larson and Miller, of strain-at-fracture curves in dependence of rupture-life are presented in addition to metallographic pictures of the fracture area and different tables. A short description of the experimental procedures is given. The calculation of the stresses in the tube and a comparison with stress-rupture tests in uniaxial state of stress are described. (GE)

27301 (LBL-2292) INFLUENCE OF HEAT TREATMENT ON THE FATIGUE CRACK GROWTH RATES OF A SECONDARY HARDENING STEEL. Horn, R. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1973. Contract W-7405-eng-48. 110p. Dep. NTIS $7.50.

Thesis.

The relationships between microstructure and fatigue crack growth properties in a 5% Mo-0.3% C steel were studied. Microstructural differences were achieved by varying austenitizing temperature and tempering treatment. These variations in treatment changed the amounts and distribution of carbides, the prior austenite grain size, and the composition of the as-quenched matrix. Optical metallography and scanning electron microscopy were used to characterize and identify the microstructures. For each heat treatment, the fatigue crack growth properties were measured under plane-strain conditions using a compact tension specimen. Fatigue crack growth rates, measured under constant tension–tension load conditions, are reported using the empirical relation of Paris ($da/dN = C_0 \Delta K^m$). Significant differences in crack growth behavior were found with different microstructures. The parameters m and C_0 of this relationship were found to vary significantly with changes in microstructure. More importantly, however, it was found that microstructural features affecting fracture toughness did not always affect fatigue crack propagation in the same way. (auth)

27302 (MLM-2118, pp 38-43) METALLURGY. 28 Feb 1974.

In Mound Laboratory activities for the Division of Physical Research: July–December 1973.

From two methods of calculation, the true value of Young's modulus for epsilon-plutonium is found to be between 6.3 and 8.7 times larger than the measured value. The compressibility value is then calculated as 2.7×10^{-12} cm^2/dyne. Tritium inventory considerations in lithium blankets of fusion reactors are discussed. (LK)

27303 (ORNL-4948) MECHANICAL PROPERTIES TEST DATA FOR STRUCTURAL MATERIALS. Quarterly Progress Report for Period Ending January 31, 1974. Hill, M. R. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 383p. AT.

The following are reported: fatigue of Type 304/308 stainless steel (SS) weldments; mechanical properties of heat-treated Inconel 718; tensile true stress-true strain of Type 304 SS at high temperatures; crack propagation in Type 304/308 SS weldments; microwave extensometer testing; correlation of thermal transient test failure data with conventional mechanical properties tests; stress-rupture and tensile prop. of 20% cold-worked Type 316 SS; elastic analysis of slit tube; testing of Type 316H FTR primary piping; neutron irradiation effects on Type 316 GTA weldments; fatigue crack growth in Type 316 SS; fracture toughness of SS and weld metal; notch ductility of ASTM Type A508 forgings; mechanical property baseline data and variation on Types 304 and 316 SS; mechanical properties of 16-8-Z and Type 308 SS weld metal; mechanical properties of 2¼ Cr–1 Mo and 9 Cr–1 Mo steels; uniaxial rupture of Type 304; and deformation of Incoloy 800. (DLC)

27304 (ORNL-TM-4396) ROOM-TEMPERATURE CHARACTERIZATION DATA OR TYPE 304 STAINLESS STEEL (HEAT 9T2796) PLATE. Swindeman, R. W. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 29p. Dep. NTIS $4.00.

One-inch plate obtained from a reference heat of type 304 stainless steel was characterized at room temperature. This charac-

terization consisted of composition, microstructure, and mechanical property evaluations relative to data available for other heats of type 304 stainless steel. The influence of laboratory reannealing was also examined. The composition was fairly typical except for below average carbon and nitrogen levels. The microstructure was fairly free of inclusions, and the grain size was coarse. The yield strength was near the 30,000 psi minimum specified for type 304 stainless steel conforming to ASTM specification A 240 and below the minimum in the reannealed condition. Possibly this was due to the coarse grain size in combination with low interstitial element content. Little, if any, differences were observed between specimens reannealed in the 1800 to 2000°F range. (auth)

27305 (ORNL-TM-4426, pp 29-33) SPIN DENSITIES. Koehler, W. C. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22–23, 1973.

Using high-purity ^{160}Gd single crystals the 4f spin distribution of Gd was measured and compared with theoretical results. The conduction electron density was also studied. (SFL)

27306 (ORO-4044-4) STUDIES OF MICROSTRUCTURE-PROPERTY RELATIONSHIPS IN AUSTENITIC STAINLESS STEEL. Progress Report, January 1, 1973–December 31, 1973. Spruiell, J. E. (Tennessee Univ., Knoxville (USA). Dept. of Chemical and Metallurgical Engineering). 1973. Contract AT(40-1)-4044. 60p. Dep. NTIS $5.00.

Research progress is reported on microstructural stability of thermal-mechanically pretreated 316 stainless steel, precipitation behavior in 321 stainless steel, stability of 316 stainless steel weldments, and characteristics of cold worked stainless steels. (JRD)

27307 (RD/B/N-2715) THERMAL CYCLING BEHAVIOR OF URANIUM-7 WT PERCENT MOLYBDENUM. Lobb, R. C.; Baker, C. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jan 1974. 17p. Dep. NTIS (U. S. Sales Only) $4.00.

Microstructural changes in a U–7% Mo alloy were studied during thermal cycling between 400 and 600°C using a density measuring technique allied with electron microscopy. During cycling, the alloy transforms from the γ phase to the stable $\gamma' + \alpha$ phases and voids are not only nucleated at carbide inclusions but also at the original γ grain boundaries which is unlike the behavior of the adjusted uranium used in Magnox reactors. This latter effect produces a large concentration of small intergranular voids which may lead to a deterioration in mechanical properties and could possibly be enlarged by the anisotropic growth stresses produced during irradiation. (auth)

27308 (SLA-73-995) EXAMINATION OF WSMR FAST BURST REACTOR FUEL. Horak, J. A.; Bishop, D. E.; Gay, E. T. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1974. Contract AT(29-1)-789. 65p. Dep. NTIS $5.25.

A program of nondestructive testing (NDT) of FBR fuel components has been developed. The thirteen FBR fuel components examined to date appear to be free of internal defects that are detectable by ultrasonic back reflection, x-radiography, and immersion density measurements; and these components should perform satisfactorily in the FBR. The maximum NDT information combined with minimum expense and ease of operation is obtained from ultrasonic back reflection combined with immersion density measurements. Physical metallography revealed a large grain size for FBR fuel rings and precipitation of a uranium carbide phase at the grain and subgrain boundaries; both of which are detrimental to the thermomechanical properties of the FBR fuel. A few of the fuel components exhibited nonuniform aluminum ion plating and evidence of being overheated during the ion plating process. (auth)

27309 (UCRL-51491) FREE-ENERGY APPROACH TO COMPUTING DYNAMIC PHASE CHANGE IN MATERIALS. Kamegai, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Nov 1973. Contract W-7405-eng-48. 25p. Dep. NTIS $4.00.

The free energy approach to calculating dynamic phase change is described. It is assumed that the driving force for the transition is the difference in the Gibbs free energy for the phases present in the material. To demonstrate the validity of the theory, the model is applied to δ-phase plutonium. (auth)

27310 COMPUTER CALCULATION OF PHASE-EQUILIBRIUM CURVES OF SOLID SOLUTIONS IN URANIUM BINARY SYSTEMS. Udovskii, A. L.; Ivanov, O. S. (Inst. of Metallurgy, Moscow). J. Nucl. Mater.; 49: No. 3, 309-321(Jan 1974).

An analysis of the existing approaches leads to a physical concept of solid solution; the computation yielded solubility curves for the systems of uranium with zirconium, hafnium, niobium, and molybdenum and for the Zr–Nb system. Limited solubility curves are computed for the Ag–Cu system in the solid state. The computed results are correlated with the experimental phase diagrams, and on the whole a good fit is obtained for all applications except for the Zr–Nb system. The expression obtained for the free energy of mixing was shown to relate to the well-known models built around the phenomenological (regular or subregular solutions) and simple statistical or physical concepts of a number of authors. (76 references) (auth)

27311 CREEP AND LONG-TERM STRENGTH OF Ti REINFORCED WITH Mo FIBERS. Umanskii, E. S.; Tuchinskii, L. I.; Krivenyuk, V. V.; Fefer, V. Ya. (Inst. of Strength Problems, Kiev). Strength Mater. (USSR) (Engl. Transl.); 5: No. 1, 23-26(Jan 1973).

Translated from Probl. Prochnosti; 5: No. 1, 24-27(Jan 1973).

The creep and long term strength under axial loading were determined using a special vacuum device. Results of the investigation show that the relationship between the load and fatigue life for the composition titanium–molybdenum and its components is described by a power function. In assessing the strength of titanium–molybdenum compositions use can be made of the law of additivity. The reinforcement of titanium by molybdenum fibers substantially improves its strength. (JRD)

27312 MECHANICAL PROPERTIES OF RECRYSTALLIZED Mo WITH MICROADDITIONS OF V. Malashenko, I. S.; Vashchilo, N. P.; Gudzenko, N. I.; Burskii, G. V. (Inst. of Electric Welding, Kiev). Strength Mater. (USSR) (Engl. Transl.); 5: No. 1, 60-64 (Jan 1973).

Translated from Probl. Prochnosti; 5: No. 1, 59-62(Jan 1973).

Results from an investigation into the physicomechanical properties of molybdenum–vanadium alloys after hot deformation and annealing are examined, and the effect of microadditions of vanadium in heat-treated polycrystalline molybdenum is analyzed. On the basis of the results it can be concluded that microalloying of molybdenum with vanadium improves the physicomechanical characteristics of recrystallized molybdenum towards increased ductility at normal and high temperatures. (auth)

27313 PROBLEMS OF THE STRENGTH OF WELDED JOINTS IN Nb AND ITS ALLOYS. Gurevich, S. M.; Nerodenko, M. M.; Asnis, E. A.; Smirnov, S. V.; Rabkina, M. D. (Inst. of Electric Welding, Kiev). Strength Mater. (USSR) (Engl. Transl.); 5: No. 1, 120-122(Jan 1973).

Translated from Probl. Prochnosti; 5: No. 1, 112-114(Jan 1973).

The static and fatigue strength of welded joints of niobium and its alloys were investigated. The experimental materials (sheets 2 mm thick) included technical grade niobium, a hardened solid-solution type alloy Nb–W–Mo–Zr (alloy 1), and a dispersion-hardening alloy Nb–Zr–C (alloy 2). All these materials were used in the recrystallized state. Butt-jointed specimens were made by automatic welding with a nonconsumable electrode in a controlled argon atmosphere. It was found that controlling the thermal cycle during welding makes it possible to increase or to reduce the length of the heat-affected zone, and, consequently, to increase or decrease its fatigue limit. Thus, reducing the length of the heat-affected zone from 3 to 1 mm made it possible to increase the fatigue limit of this zone in unalloyed niobium specimens from 10 to 12 kg/mm^2. (auth)

27314 EFFECT OF PLASTIC DEFORMATION ON ELECTRICAL RESISTANCE OF Mo SINGLE CRYSTALS. Pirogova, S. V.; Burov, I. V.; Savitskii, E. M. (Inst. of Metallurgy, Moscow). Strength Mater. (USSR) (Engl. Transl.); 5: No. 2, 209-211(Feb 1973).

Translated from Probl. Prochnosti; 5: No. 2, 73-75(Feb 1973).

A study was made of the contribution of various defects arising during plastic deformation, on the electric conductivity of Mo. A comparison of the contributions made to the electrical resistance of Mo by different types of lattice defects reveals that point defects of the vacancy and impurity atom type present in a solid solution have a marked effect on the electrical resistance, whereas linear defects (dislocations) have only a negligible effect. At 4.2°K 1 at. % niobium increases the electrical resistance of pure molybdenum by two orders of magnitude, the electrical resistance due to 1 at. % vacancies is 4×10^{-5} Ω·cm, and the contribution made by dislocations is approximately 10^{-16} Ω·cm^3. (auth)

27315 STRENGTH CHARACTERISTICS OF LAYERS PRODUCED BY ELECTROSPARK ALLOYING OF STEELS WITH REFRACTORY METALS. Pisarenko, G. S.; Samsonov, G. V.; Verkhoturov, A. D.; Bezykornov, A. I.; Lyashenko, B. A.; Rishin, V. V.; Shemegan, Yu. M. (Inst. of the Strength of Materials,

Kiev). Strength Mater. (USSR) (Engl. Transl.); 5: No. 2, 247-252(Feb 1973).

Translated from Probl. Prochnosti; 5: No. 2, 106-111(Feb 1973).

An investigation was conducted into the strength of layers obtained by electrospark alloying of iron and steel cathodes by refractory metals. It was established that when cathode materials are strengthened by metals that form unlimited solid solutions with them and have low (below 20°C) temperatures of transition to the brittle condition, the highest values of σ_{sd} and τ_{sh} are found. The stresses in the strengthened layer are tensile and they are lowest in the case of strengthening by metals that form unlimited solid solutions with the cathode material. As a result of the high residual tensile stresses in the surface layer, the fatigue strength of the alloyed samples is lower than in the unstrengthened ones. To reduce residual tensile stresses and, consequently, to increase the fatigue strength of alloyed parts it is desirable to employ a short-circuiting current less than 20 A, a protective interelectrode medium such as argon, strengthening with an anode material that forms with the cathode material an unlimited solid solution, and fine grinding of the alloyed surface, especially by electromechanical means. (auth)

27316 TITANIUM CORNER OF THE Ti–Al–W PHASE DIAGRAM. Oleinikova, S. V.; Nartova, T. T.; Kornilov, I. I. Izv. Akad. Nauk SSSR, Metal.; No. 3, 218-223(1973). (In Russian).

Alloys containing up to 20% Al and 20% W are studied by x-ray phase, differential thermal, and microstructure analysis methods. The specific electroresistance, modulus of elasticity, and hardness are also determined as a function of the composition. According to a series of cuts paralleling the Ti–Al and Ti–W sides composition-property curves are constructed and these are used for making more precise the phase boundaries at 600°C. The solubility of Al and W in the α, α_2, and solid solutions is determined at 1100, 1000, 800, and 600°C. Non-variant four-phase conversion of the II type occurs in the Ti–Al–W system at 925°C. The polythermal and isothermal cross sections of the phase diagram are constructed. (tr-auth)

27317 PHASE DIAGRAM OF THE TITANIUM CORNER OF THE Ti–Ta–V–Mo SYSTEM. Nikitin, P. N.; Mikheev, V. S.; Rudnev, N. F. Izv. Akad. Nauk SSSR, Metal.; No. 3, 229-232 (1973). (In Russian).

The phase diagram of the Ti–Ta–V–Mo system is constructed in the region of the Ti corner at concentrations up to 60 wt. % for all the alloying elements. In β-Ti, Ta, V, and Mo with mutual interaction are dissolved unconditionally but in α-Ti the solubility is limited. At $t < 882$°C three phase volumes occur: α-phases, $(\alpha + \beta)$ phase, and β solid solutions. The specific electroresistance and the hardness of the alloys of the Ta : V : Mo = 1 : 1 : 1 cut are determined in the annealed and tempered state. (tr-auth)

27318 ANGULAR AND AMPLITUDE DISPERSIONS OF THE ANISOTROPY OF ELECTROLYTIC FILMS OF Ni–Fe–Mo WITH BIAXIAL ANISOTROPY. Bursuc, I. D. (Univ., Iasi); Cucureanu, C.; Grimberg, R. Thin Solid Films; 20: No. 2, 223-226(Feb 1974). (In French).

The angular and amplitude dispersions of the anisotropy in Ni–Fe–Mo films with biaxial anisotropy have been studied. The permalloy films had a thickness of 5000 Å and those of permalloy with 5% Mo a thickness of 5400 Å. The films were deposited onto plane copper substrates. The angular and amplitude dispersions, measured by the resonance absorption method, decrease with an increase in the angle between the anisotropy axes, having values of 4° and 2.8 Oe, respectively, for the permalloy films with an angle of 5° between the axes, and 2° 30′ and 2 Oe for films with an angle of 22° between the axes. For the permalloy films with Mo the dispersions decrease from 7° 30′ and 3.2 Oe to 6° 30′ and 2.9 Oe for an increase of the angle between the anisotropy axes from 10 to 20°. The time variation (over 1000 h) of the angle between the anisotropy axes is given. Decreases from 22° to 17° and from 10° to 7° respectively for permalloy and permalloy with 5% Mo are obtained. (auth)

27319 OPTICAL CONDUCTIVITY AND TRANSITIONS IN Yb THIN FILMS. Petrakian, J. P. (Universite de Provence, Marseille). Thin Solid Films; 20: No. 2, 297-305(Feb 1974). (In French).

It is shown that the optical properties of alkaline rare-earth thin films differ from those of other lanthanides. The spectral variations of the optical absorptions of ytterbium and strontium are similar. The optical conductivity of ytterbium exhibits a maximum near 1.5 eV. In the visible region, the thickest films present an absorption peak near 2.8 eV. Selection rules are calculated for the fcc structure of ytterbium. It can be seen that the experimental results are consistent with the allowed interband transitions. (auth)

27320 ELECTRICAL RESISTIVITY OF YTTERBIUM THIN FILMS. Janos, S.; Feher, A. (Safarik Univ., Kosice, Czech.). Thin Solid Films; 20: No. 2, S45-S46(Feb 1974).

A model is presented to explain results of electric conductivity measurements on Yb films. The model provides good approximation for the reduced electron mean free path. A modified equation for electric conductivity is included. (JRD)

27321 EFFECT OF ALKAI METAL OXIDES ON PHASE FORMATION OF THE Al–Mo SYSTEM. Shneivais, L. V.; Talipov, G. Sh. Azerb. Khim. Zh.; No. 2, 28-32(1973). (In Russian).

The effect of small additions of Me_2O (Me = Li, Na, K, Rb, and Cs) on the phase composition of the Al–Mo system is studied by infrared spectroscopy and x-radiography. The results show that the addition of these oxides lead to changes in the phase composition. The addition of 1 to 10 millimoles to 100 g of the base alloy promotes the formation of $Al_2(MoO_4)_3$. The addition of greater quantities leads to the destruction of the original phase and formations of a new structure. (JSR)

27322 ADSORPTION OF OXYGEN AND NITROGEN ON TANTALUM FILMS. V. Fromm, E.; Duppel, H.; Bauder, U. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk.; 64: No. 12, 910-913(Dec 1973). (In German).

At 77°K the sticking probability for nitrogen on gas-free films has a constant value of 1, and at a coverage of approximately 7×10^{14} molecules/cm^2 it falls rapidly some 5 to 6 orders of magnitude. The electrical resistance is hardly affected by the adsorption process. Heating the film to 300°K leads to a very rapid increase in pressure. Exposing the film again to nitrogen at 77°K shows that the coverage at which the sticking probability falls is now considerably smaller. Repeated heating to 300°K does not further change in the reaction. From measurements of the increase in pressure it can be concluded that the first nitrogen exposure results in a rapid chemisorption. Afterwards, nitrogen molecules are reversibly physisorbed on the chemisorbed layer. Additional nitrogen-exposure of the same film results only in physisorption. The maximum amount of physisorbed nitrogen is approximately 3.5×10^{14} molecules/cm^2. (GE)

27323 CREEP AND LONG-TERM STRENGTH OF Mo WITH BORON SILICIDE COATING IN A VACUUM AT 1000 TO 1400°C. Zelenyuk, E. E.; Krivenyuk, V. V.; Sosnovskii, L. A. (Inst. of Strength of Materials, Kiev). Strength Mater. (USSR) (Engl. Transl.); 5: No. 2, 188-191(Feb 1973).

Translated from Probl. Prochnosti; 5: No. 2, 53-56(Feb 1973).

The investigations were made at 1000 to 1400°C on commercially pure specimens of Mo. The test durations ranged from 0.1 to 2000 h. It was found that boron silicide coatings increase the long-term strength of molybdenum at temperatures up to 1400°C in a vacuum. If stress concentrators are lacking, the coating has no effect on plasticity of the base material. The presence of concentrators causes a diminution in plasticity characteristics. Application of a coating causes no quantitative change in the curve of long-term strength of the material. (JRD)

27324 DETERMINATION OF THE HIGH BOND DISSOCIATION ENERGY OF THE MOLECULE LaRh. Cocke, D. L.; Gingerich, K. A.; Kordis, J. (Texas A and M Univ., College Station). High Temp. Sci.; 5: No. 6, 474-481(Dec 1973).

The Knudsen effusion mass spectrometric technique has been used to determine the bond dissociation energy of the molecule LaRh. The enthalpy changes of the following reactions: (1) LaRh gas (g) = La(g) + Rh(g) and (2) LaRh(g) + C(g) = La(g) + RhC(g) have been determined. The second law value of ΔH^0_{298} corresponding to reaction (1) is 126.0 ± 3.5 kcal. Experimental data for reactions (1) and (2) were treated by the third law method in terms of both a LaRh double and triple bond. Weighted averages of results from these treatments yielded ΔH^0_{298} for reactions (1) and (2) as 126.5 ± 0.8 and −9.8 ± 1.3 kcal, respectively. The reaction enthalpies of reaction (1) yielded the dissociation energy D^0_{298} = 126.0 ± 4.0 (D^0_1 = 125.4 ± 4.0) kcal mole^{-1} or 527.2 ± 16.7 (524.7 ± 16.7) kJ mole^{-1}. This high value is supported by reaction (2). The bond dissociation energy represents the highest measured between ligand-free metal atoms and is interpreted in terms of the various empirical models of bonding. LaRh seems to have multiple bonding with heavy involvement of d-orbitals. The standard heat of formation, $\Delta H^0_{f,298}$, of LaRh is 109.2 ± 4.2 kcal or 456.9 ± 17.6 kJ mole^{-1}. (auth)

27325 STRUCTURE OF LIQUID SODIUM FROM MONTE CARLO CALCULATIONS. Fowler, R. H. (Oak Ridge National Lab., TN). J. Chem. Phys.; 59: No. 6, 3435-3436(15 Sep 1973).

The structure function of liquid Na was determined using the Monte Carlo method and the SST (Shyu–Singwi–Tosi) potential. Results agree with molecular dynamics calculations and experimental values. (DLC)

27326 MEASUREMENT OF MELT DENSITY OF REFRACTORY MATERIALS. Ivashchenko, Yu. N.; Martsenyuk, P. S. (Inst. of Materials Handling Problems, Kiev). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 1, 64-66(Jan 1973).

Translated from Zavod. Lab.; 39: No. 1, 42-45(Jan 1973).

The method consists of measuring the volume of the drop breaking off from the sample, indirectly from its dependence on the radius of the circle of contact of the drop with the solid, and on the capillary constant of the melt. To study the effect of viscosity, experiments were conducted on standard liquids ($C_3H_8O_3$, $C_3H_6O_3$, CCl_4, H_2O) and also on Ti, Zr, and Hf. Results agree with literature values within the experimental error. (DLC)

27327 PHASE ANALYSIS OF NIOBIUM ALLOYS. Lashko, N. F.; Zimnevich, T. N.; Bogina, N. Kh.; Kozlova, M. N. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 3, 362-364(Mar 1973).

Translated from Zavod. Lab.; 39: No. 3, 263-266(Mar 1973).

Optimum conditions were established for the separation of phases in the Nb–C, Nb–Zr–C, Nb–Mo–C–N, Nb–Mo–Zr–C, and Nb–Mo–Zr–Ti–Cr–C systems containing interstitial impurities at concentrations between hundredths and tenths of a percent. (LK)

27328 ELECTROCHEMICAL SEPARATION OF PHASES IN ALLOYS OF THE Co–W–C SYSTEM. Stegnukhina, L. V.; Yakovleva, E. F.; Zimina, L. N.; Knyazheva, V. M. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 3, 358-361(Mar 1973).

Translated from Zavod. Lab.; 39: No. 3, 260-263(Mar 1973).

Optimum conditions for electrochemical selective separation of the Co_3W and WC phases in Co–26% W–0.4% C and Co–26% W–10% Ni–0.4% C alloys were determined. (LK)

27329 HIGH TEMPERATURE HEAT CONTENT OF LIQUID YTTRIUM BY LEVITATION CALORIMETRY. Stretz, L. A.; Bautista, R. G. (Ames Lab., Iowa). Met. Trans.; 5: No. 4, 921-928(Apr 1974).

A 15 kVa, 450 kHz radio-frequency generator was used to levitate and melt yttrium samples ranging from 0.5 to 2 g in an inert atmosphere before being dropped into a copper block drop calorimeter contained in isothermal surroundings. The yttrium data were fitted by the following equation: $H_T - H_{298.15} = [39.725 \pm 0.544](T - 1799) + [64,116.655 \pm 163.285]$ J/mol for $1799 < T < 2360$°K. Heat contents measured were corrected for convection and radiation heat losses during the fall of the sample from the levitation chamber into the calorimeter. The maximum estimated error for the levitation calorimetry method was ±2.5%. (5 tables, 9 figures) (auth)

27330 NUCLEATION LIMITATION AND HARDENABILITY. Sharma, R. C.; Purdy, G. R. (McMaster Univ., Hamilton, Ont.). Met. Trans.; 5: No. 4, 939-947(Apr 1974).

The relation between nucleation theory and hardenability of steels has been critically examined. The effect on hardenability of most elements with the exception of B and strong carbide forming α-stabilizers, is found to be semiquantitatively consistent with classical nucleation theory. The "anomalous" effects of B, Cr, and Mo are discussed in terms of possible physical interference of precursor reactions with ferrite formation. (14 figures, 37 references) (auth)

27331 OBSERVATIONS ON WORK HARDENING OF POLYCRYSTALLINE IRON AND NICKEL CONTAINING NON-DEFORMABLE PARTICLES. Jones, R. H. (Westinghouse Electric Corp., Pittsburgh). Met. Trans.; 5: No. 4, 970-971(Apr 1974).

Ashby's secondary work hardening model for single crystals containing hard particles was extended to the reported stress–strain behavior of Fe–0.9 and 1.7% ThO_2 and Ni–1 to 3% ThO_2 alloys. The constant C in the equation $\tau = \tau_y + CG(bf\gamma/\overline{D})^{\frac{1}{2}}$ was found to be 0.35 to 0.45 for bcc, and 0.6 for high-stacking fault energy fcc metals containing hard particles. C was found to increase linearly with temperature for Fe–ThO_2. (DLC)

27332 MORPHOLOGY AND SUBSTRUCTURE OF MARTENSITE IN MARAGING STEELS. Wirth, A. (Sheffield Polytechnic, Eng.); Bickerstaffe, J. Met. Trans.; 5: No. 4, 799-808(Apr 1974).

Thin-foil transmission electron microscopy, x-ray diffraction, and dilatometry were used to study the martensitic $\gamma \rightarrow \alpha$ transformation in three steels with nominal contents of 8% Ni and 0.2% Be and Cr contents of 12, 14, and 16%. In each case the martensite formed as laths with a habit plane close to $\{225\}_\gamma$. With increasing Cr content and increasing cooling rate, greater numbers of the laths were observed to be internally twinned. Detailed analysis of the martensitic transformation suggested that the internally twinned laths are formed by a sequence of $\gamma \rightarrow \epsilon$ or faulted $\gamma \rightarrow \alpha'$. The orientation relationships between the three phases γ, ϵ, and α, determined from selected-area diffraction analysis, corresponded to Kurdjumov–Sachs. (16 figures, 29 references) (auth)

27333 EFFECT OF THERMAL AGING UPON THE FATIGUE-CRACK PROPAGATION OF AUSTENITIC STAINLESS STEELS. James, L. A. (Westinghouse Hanford Co., Richland, WA). Met. Trans.; 5: No. 4, 831-838(Apr 1974).

Elevated temperature fatigue-crack propagation behavior of several austenitic stainless steels was investigated using linear-elastic fracture mechanics. The steels studied were AISI Types 304, 304L, 316 (both annealed and cold-worked), and weldments in Type 304 using Type 308 filler. Aging temperatures of 1000 and 1200°F were employed, with times from 1500 and 6000 h. Thermal aging produced lower crack growth rates, and it is suggested that the precipitation of the various carbide and intermetallic phases is responsible for the beneficial effect. One possible mechanism might be a blunting effect each time the crack tip encounters a second-phase particle, thereby requiring the crack to partially reinitiate itself before proceeding. (12 figures, 39 references) (auth)

27334 WORK STRENGTHENING IN A Fe–Ni–Co–Cr–Mo ALLOY. Michels, H. T.; Forbes Jones, R. M. (International Nickel Co., Inc., Suffern, NY). Met. Trans.; 5: No. 4, 847-851 (Apr 1974).

The effect of cold work on the mechanical properties and microstructure of an fcc Fe–Ni–Co–Cr–Mo alloy is discussed. In samples deformed up through 20%, strengthening is attributed to an increase in dislocation content. Greater deformation (48 and 75%) results in the formation of deformation twins which increase in density with cold working. The deformation twins contribute to the high yield strength (0.2% offset) of 154 kg/mm² which is attained in this alloy upon cold working (75% elongation). This hardening mechanism is in contrast with that reported to be operating in a similar fcc Co–Ni–Cr–Mo alloy in which strengthening is attributed to the formation of a deformation-induced fine hcp epsilon phase. (8 figures) (auth)

27335 SURFACE SEGREGATION AND INTERACTION OF OXYGEN AND NITROGEN WITH ZIRCONIUM IN Nb–1% Zr ALLOY. Joshi, A.; Varma, M. N.; Strongin, M. (Brookhaven National Lab., Upton, NY). Met. Trans.; 5: No. 4, 861-863(Apr 1974).

Surface segregation and interaction of Zr, O, and N were studied in a Nb–1% Zr alloy utilizing Auger electron spectroscopy. Segregation of oxygen to the surface occurs at temperatures as low as 500°C with the maximum occurring around 1300°C. O at the surface appears to be in two states, one of which corresponds to a strongly bound state with Zr. O in this state, like Zr, does not redistribute into the bulk at high temperatures. Segregation of N to surfaces is observed in samples cooled from temperatures above 1000°C. The segregation of Zr, O and N is limited to a few monolayers near the surface. When heated above 1500°C, O and Zr are removed from the sample, probably in the form of oxides of Zr and Nb. (auth)

27336 ISOTHERMAL PRECIPITATION IN A U–2.5 at. % Ti ALLOY. Stelly, M. (CEN, Saclay, Gif-sur-Yvette, France). J. Nucl. Mater.; 49: No. 3, 245-256(Jan 1974). (In French).

Isothermal precipitation between 500 and 650°C in a U–2.5 at. % Ti alloy was studied by various methods. To establish precipitation kinetics, the electrical resistance of samples was continuously measured at the aging temperature or, at intervals, at 300°K and 77°K. A deviation from Matthieson's law, already established for uranium–aluminum alloys, was found here also. The several stages seen in the aging curves are explained; in particular the influence of the high resistivity of U_2Ti on the high-temperature resistivity values is shown. The apparent activation energy for precipitation is 1.1 ± 0.1 eV. Micrographic observations have demonstrated the existence of three different forms of precipitate: cellular precipitation at the old γ grain boundaries, precipitates at the junctions of α needles and oriented rods following a single direction in the needles. These rods form the major part of the precipitate, and their orientation relationships with the matrix were determined. The results are compared with those obtained for a U–2.7 at. % Mo alloy of similar structure and supersaturation. (auth)

27337 SHORT-RANGE STRUCTURE OF Ti AND Zr BCC SOLID SOLUTIONS CONTAINING THE ω PHASE. I. General Diffraction Theory and Development of Computational Techniques. Borie, B.; Sass, S. L.; Andreassen, A. (Cornell Univ., Ithaca, NY). Acta Crystallogr., Sect. A; 29: No. 6, 585-594(1 Nov 1973).

Certain Ti and Zr solid solutions containing the ω phase exhibit intensity distributions in reciprocal space which are partly diffuse. In an effort to understand the structural meaning of these diffraction patterns, new methods were developed for the evaluation of the kinematic intensity sum for certain kinds of atomic arrangements which are not quite periodic. The methods are illustrated by their application to a simple model for these alloy

systems. The model successfully reproduces some but not all of the features of observed intensity distributions. (auth)

27338 CUBIC-TO-TETRAGONAL TRANSFORMATION AND SUSCEPTIBILITY IN $LaAg_xIn_{1-x}$ ALLOYS. Ihrig, H.; Vigren, D.T.; Kübler, J.; Methfessel, S. (Abteilung für Physik, Ruhr-Universität, Bochum, Germany). Phys. Rev. B 8: No. 10, 4525-4533 (15 Nov 1973).

The magnetic susceptibility χ (x,T) of the pseudobinary intermetallic compound $LaAg_xIn_{1-x}$ is given for temperatures T between 20 and 250 K with x between 1.0 and 0.15. For x between 0.9 and 0.6, χ is very anomalous, rising strongly as the samples are cooled until a temperature $T_M(x)$ is reached where a cubic-to-tetragonal crystallographic transformation is found to occur and the susceptibility drops to a much lower value. The transformation is shown to arise from a band Jahn-Teller effect. The behavior of χ (x,T) as well as $T_M(x)$ can be described quantitatively over a broad range of x assuming that the Fermi energy of LaAg lies closely below a high peak in the density of states which originates from the e_g states of La. This peak becomes gradually populated as the electron concentration is increased by replacing Ag by In. (auth)

27339 KERR AND HALL EFFECTS IN FERROMAGNETIC ALLOYS. Voloshinskaya, N. M.; Fedorov, G. V. (Inst. of Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 36: No. 5, 946-956(Nov 1973). (In Russian).

Normal and abnormal Hall and Kerr effects in the ferromagnetic alloys Fe-V, Co-Al, and Ni-Al were studied in the spectrum range 0.4 to 1.8 μ. It was shown that the general path of dispersion of the nondiagonal component of the tensor of dielectric penetrability at the wavelengths studied could be described by the mechanism of interpolar absorption. This concept is in agreement with optical data and with the results of measurements of the coefficient of the anomalous Hall effect. (10 Figs.) (tr-auth)

27340 MAGNETIC CRYSTALLINE ANISOTROPY OF $SmCo_5$ INTERMETALLIC COMPOUNDS. Korolev, A. V.; Ermolenko, A. S. (Inst. of Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 36: No. 5, 957-964(Nov 1973). (In Russian).

Causes of the large differences reported by different authors, in the anisotropy constants K_1 for compounds of the type RCo_5 were analyzed. Among these causes are the heterogeneity and block shape of samples and their imprecise orientation relative to the magnetic field during measurement. The concentration dependence of K_1 and the specific magnetic saturation of solid solutions of cobalt based on the compound $SmCo_5$ was studied. The value of K_1 was measured as $(19.3 \pm 1.4) \times 10^7$ ergs/cm^3 and the field of anisotropy as 440 ± 20 kOe. (tr-auth)

27341 MAGNETIC AND HYSTERESIS PROPERTIES OF COMPOUNDS OF RARE EARTH METALS WITH IRON. Bisliev, A. M.; Nikitin, S. A.; Savitskii, E. M.; Terekhova, V. F.; Kolesnichenko, V. E. (Moscow State Univ.). Fiz. Metal. Metalloved.; 36: No. 5, 965-970(Nov 1973). (In Russian).

Magnetic moments on the RFe_2 molecule (R = Gd, Tb, Dy, Ho, Er, Tm, Y, or Lu) were determined by measuring the magnetization curves at 4.2°K in fields up to 50 kOe. The magnetic moment on the rare earth ion was shown to be less than that on the free trivalent ion. In a study of the temperature dependence of the coefficient of force, a clear dual maximum was observed close to the temperature of magnetic compensation in $ErFe_2$. The Curie point was determined by a thermodynamic method. The increase in the Curie points with increase in spin from Lu and Y to Gd is explained by the marked contribution of the overall interaction of the rare earth ion sublattices with the Fe sublattice. (tr-auth)

27342 ELECTRICAL RESISTANCE OF V CONTAINING Ta. Chernoplekov, N. A.; Panova, G. Kh.; Samoilov, B. N.; Zhernov, A. P.; Shikov, A. A. Fiz. Metal. Metalloved.; 36: No. 5, 978-982 (Nov 1973). (In Russian).

The temperature dependence of the electrical resistance of pure vanadium, $\rho_0(T)$, and its alloys with Ta (0.82, 3.55, 5.68 at. %) was measured at 5.2 to 300°K. At intermediate temperatures, the additive resistance, $\Delta\rho = \rho(T) - \rho_0(T) - \Delta\rho(0)$, went through a maximum and depended nonlinearly on the additive concentration, c. At the high temperature limits, $\Delta\rho \approx cT$, with $\partial\Delta\rho/\partial T < 0$. It was concluded that the value of $\Delta\rho$ at the maximum is at least 50% due to dispersion of electrons on quasi local oscillations. A positive sign of the derivative is determined by the difference in force constants of interaction between atoms of the solution compared to those of the original vanadium matrix. Theoretical considerations developed for the temperature dependence of the resistance of the nontransition metal with nonmagnetic impurities qualitatively described the temperature dependence of the resistance of the alloys of the transition metals studied. (tr-auth)

27343 NUCLEAR MAGNETIC RESONANCE IN V-Cr-Si AND V-Cr-Ge COMPOUNDS HAVING THE A15 STRUCTURE. Zhuzhgov, V. M.; Pryadein, V. I.; Stepanov, A. P. (Inst. of Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 36: No. 5, 987-993(Nov 1973). (In Russian).

The temperature (-150 and 0°C) and concentration dependence of the form of the line and the Knight shift of ^{51}V in the superconducting alloys $(V_3Si)_{1-x}(Cr_3Si)_x$ and $(V_{3.64}Ge_{0.36})_{1-y}(Cr_3Ge)_y$ when $0 \le x \le 0.95$ and $0 \le y \le 0.75$ mole fraction. At concentrations near 0.30, both systems had anomalies in the sign of the temperature dependence, the value of the Knight shift, and the width of the δ H line. Qualitative analysis showed that the width of the lines of these compounds is determined by two mechanisms: dipole interaction of nuclear spins and discontinuous widening by anisotropic Knight shift. The anomaly in the concentration dependence of δ H is explained by the unidimensional lattice of V atoms in this structure. For analysis of the Knight shift, a model with two temperature-dependent contributions of different signs was used. In six of the $(V_3Si)_{1-x}(Cr_3Si)_x$ systems, the quadrupole interaction constant e^2qQ/h, was measured. (tr-auth)

27344 DIFFUSION CREEP OF POLYCRYSTALS WITH INTERGRANULAR PHASE INTERLAYERS. Geguzin, Ya. E.; Kibets, V. I. (Kharkov State Univ.). Fiz. Metal. Metalloved.; 36: No. 5, 1043-1050(Nov 1973). (In Russian).

The possible role of intergranular phase interlayers as one path of diffusion transfer of mass in high-temperature diffusion deformation of polycrystals of refractory metals is considered. An approximate theory of the process of deformation of polycrystals with phase interlayers is presented; asymptotic formulas were obtained. Experiments were carried out on creep of tungsten with nickel additive. Results of the measurements are interpreted within the framework of statements about the deformation mechanism. (tr-auth)

27345 CRYSTAL-STRUCTURE STUDY OF EUTECTOID DISINTEGRATION OF Cu-Be ALLOYS. Structure Change in β'' Phase Cu_2Be in Process of Ordering. Tyapkin, Yu. D.; Golikov, V. A. (Inst. of Physical Metallurgy and Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 36: No. 5, 1058-1070(Nov 1973). (In Russian).

Methods based on electron diffraction, electron microscopy, and diffusion dispersion of x rays were used in studying changes in crystal structure of copper alloys with 24.30, 30, and 31 at. % Be in the process of formation of ordered β'' phase Cu_2Be, i.e., in the stage preceding actual eutectoid disintegration. The nature of the β''-phase defects was established in the form of antiphase limits along the (001) planes and the reciprocal arrangement of the fields with different orientations of the β'' phase. (7 Figs.) (tr-auth)

27346 INTERSECTION OF GRAIN BOUNDARIES BY FRICTION STREAKS AS A MECHANISM OF VISCOUS GRAIN BOUNDARY DISINTEGRATION. Rybin, V. V.; Likhachev, V. A.; Vergazov, A. N. Fiz. Metal. Metalloved.; 36: No. 5, 1071-1078(Nov 1973). (In Russian).

Fissure fracture of samples of 99.9% pure Mo and Ti-6% Al alloy, crushed at room temperature under conditions of viscous uniaxial tension, was studied. It was shown that, under conditions such that disintegration occurred at the grain boundary, traces of emergence of plastic deformation bands were observed on the fissure surfaces. A possible mechanism of disintegration is analyzed. Arguments are presented in support of the mechanism of viscous grain-boundary disintegration observed earlier in nickel. Disintegration occurred as a result of accumulation, during plastic deformation, at the grain boundaries of nonconformity dislocations with a large and different Burgers vector. A quantitative evaluation of the criteria of destruction is made which agrees well with experimental results. (tr-auth)

27347 HARDENING OF MOLYBDENUM IN LIQUID HELIUM-2. Mamalui, A. A.; Pervakov, V. A.; Khotkevich, V. I. (Gorky State Univ., USSR). Fiz. Metal. Metalloved.; 36: No. 5, 1101-1102(Nov 1973). (In Russian).

A marked dependence of the completeness of hardening under the experimental conditions indicated that in the process of hardening, the high-temperature defects were destroyed chiefly by their drift to stable channels, which are chiefly boundaries of grains and the surface of the sample. The energy of formation of defects in molybdenum was found to be 2.6 eV, which agrees with results of high-temperature determination of vacancies from the temperature dependence of the heat capacity. The energy of activation of transfer of hardened defects in molybdenum was found to be 1.9 eV. (TTT)

27348 NEUTRON DIFFRACTION AND MAGNETIZATION STUDY OF HEUSLER ALLOYS CONTAINING Co AND Zr, Hf, V, OR Nb. Ziebeck, K. R. A.; Webster, P. J. (Salford Univ., Eng.). J. Phys. Chem. Solids; 35: No. 1, 1-7(Jan 1974).

Neutron diffraction, x-ray diffraction, and saturation magnetization measurements have been made on a series of ferromagnetic

alloys at the composition Co_2YZ, where Y is a group IVA or VA element and Z is a group IIIB or IVB element. The alloys are mainly ordered in the Heusler $L2_1$ type chemical structure, but some show the presence of a small amount of additional phase, or some preferential disorder. The magnetic results form two distinct groups in which the moments are confined to the Co sites but their magnitude depends on the electron concentration determined by the Y and Z atoms. Although the magnetic moments and Curie temperatures of the alloys in the same group are similar, their lattice parameters differ according to whether Z is a group IIIB or IVB element. Such behavior indicates that, as in other alloy series with the Heusler structure, a change in lattice parameter has little effect on the magnetic properties in comparison with the effect of a change in electron concentration. (auth)

27349 NEW BEHAVIOUR OF THE INTERSTITIAL ELEMENT H OR D IN SOLUTION IN RARE-EARTH METAL. Daou, J. N.; Bonnet, J. E. (Centre National de la Recherche Scientifique, Orsay, France). J. Phys. Chem. Solids; 35: No. 1, 59-65(Jan 1974).

A study of the resistivity of the Lu- (H or D) system makes clear certain characteristics of the α phase and indicates a change for the interstitial element in the transition range 170 to 400°C. On both sides of this domain an appreciable difference is observed in the properties of the solid solution. The α^* phase of the domain below 170°C has a higher resistivity and a maximum hydrogen concentration independent of the temperature. For the α phase of the domain above 400°C, the expansions both with the concentration growth and with the rise in temperature are isotropic contrary to the α^* phase. From resistivity and x-ray diffraction studies, taking into account the lattice symmetry, it is concluded that a change may occur in the type of interstices filled by the hydrogen atoms, tetrahedral for the α phase and octahedral with H atoms associating in pairs for the α^* phase. Among the lanthanide metals only lutetium and thulium, in uniting with H or D, have the low temperature α^* phase. (auth)

27350 MELTING TEMPERATURE OF URANIUM AT HIGH PRESSURES. Ganguly, J.; Kennedy, G. C. (Univ. of California, Los Angeles). J. Phys. Chem. Solids; 34: No. 12, 2272-2274 (Dec 1973).

An investigation is reported into the effect of pressure on the melting temperature of uranium. The uranium was encapsulated in tantalum and allowance was made for the slight alloying effects of tantalum and uranium oxide. The experiments were carried out in a piston-cylinder apparatus essentially similar to that described by Cohen et al., (J. Phys. Chem. Solids; 27: 179(1966)). The estimated, corrected melting curve for pure uranium is presented for pressures from 9 to 41.4 kbar. (UK)

27351 REACTION OF NITROGEN WITH BURNING BERYLLIUM DROPLETS. Prentice, J. L. (Naval Weapons Center, China Lake, CA). Combust. Sci. Technol.; 5: No. 6, 273-285(Aug 1972).

The results of a systematic quantitative study of the combustion of single laser-ignited beryllium droplets burning in mixtures of oxygen/nitrogen are described. Nitrogen is shown here to raise the ignition limit and retard the combustion relative to oxygen/argon. Nitrogen-induced fragmentation of beryllium droplets is demonstrated for the first time. The results of these studies are compared with earlier quantitative data on beryllium droplets burning in oxygen/argon and it is shown that the rates, mechanisms, and nature of the debris from burning are all affected by environmental species. The significant contribution of condensed phase processes occurring at the droplet surface to the overall combustion reveal clearly the inadequacy of a vapor phase combustion model for beryllium. (auth)

27352 SHORT-RANGE STRUCTURE OF Ti AND Zr BCC SOLID SOLUTIONS CONTAINING THE ω PHASE. II. Solution of the Structure Determination. Borie, B.; Sass, S. L.; Andreassen, A. (Cornell Univ., Ithaca, NY). Acta Crystallogr., Sect. A; 29: No. 6, 594-602(1 Nov 1973).

New techniques for computing intensity distributions from atomic arrangements with defects in periodicity were applied to a variety of models in an attempt to reproduce in detail the diffuse neutron-diffraction pattern of a Zr-20 wt % Nb alloy quenched from 1273°K. The model which succeeds is described, and its kinematic intensity sum is derived. The resultant computed diffuse intensity distribution is compared with experiment. (auth)

27353 FORMATION OF LOCALIZED MOMENTS IN METALS: EXPERIMENTAL BULK PROPERTIES. Rizzuto, C. (Univ., Genoa). Rep. Progr. Phys.; 37: No. 2, 147-229(1974).

This review presents systematically most of the experimental data which have been obtained from measurements of bulk properties of alloys and intermetallic compounds containing atoms of transition metals, rare earths, or actinides which can be considered as non-interacting with each other. Criteria for the observation of effects due to non-interacting atoms are given. Data are reported from measurements of magnetic properties, electrical resistivity, specific heat, superconductivity, thermoelectric power, thermal conductivity, thermal expansion and compressibility, De Haas-van Alphen and Hall effects, and optical properties. Systematic trends in experimental behavior can be observed in many of these data, and experimental parameters are defined which are used to classify the data before attempting a comparison with theories. (auth)

27354 KONDO RESISTIVITY OF Pr-Ce ALLOYS. Altunbas, M.; Taylor, K. N. R.; Wilkinson, G. A. (Univ. of Durham, Eng.). Phil. Mag.; 29: No. 2, 349-371(Feb 1974).

The electrical resistivity of double hcp Pr-Ce alloys containing up to 25 at. % Ce was studied at 1.3 to 300°K. In addition to the usual divergence at T = 0°K, evidence was found of structure at about 20 and 90°K. This was tentatively ascribed to the presence of Kondo sidebands of the type discussed by Maranzana (Maranzana, F. E., 1970, Phys. Rev. Lett., 25: 239) and was related to the cerium crystal field levels expected in the alloys on the basis of Rainford's (Rainford, B. D., 1971, A. I. P. Conference Proc. No. 5, Magnetism and Magnetic Materials, pp. 591-610) crystal field parameters for pure Pr. Evidence was also obtained under certain conditions for the existence of antiferromagnetic ordering in the alloys at around 26°K, similar to that observed in pure Pr by Meaden and his co-workers (Meaden, G. T., Krithivas, G. and Sze, N. H., 1972, J. Phys. Soc. Japan, 33: 1584). (auth)

27355 SELF DIFFUSION IN VANADIUM SINGLE CRYSTALS. Pelleg, J. (Nuclear Research Centre-Negev, Beersheba, Israel). Phil. Mag.; 29: No. 2, 383-393(Feb 1974).

Self-diffusion of ^{48}V in vanadium single crystals was reinvestigated at 724 to 1842°C. Contribution to diffusion from migration along short-circuit paths at the lower temperatures was avoided using a special microsectioning technique. The change in slope of the Arrhenius curve, reported to occur at about 1350°C, was observed to occur in the vicinity of 1642°C. The data in the temperature range 724-1642°C can be fitted to the relation $D = (2.88^{+1.1}_{-0.7}) \times 10^{-1} \exp[-(73936 \pm 306)/RT]$, consistent with normal diffusion by a single-vacancy mechanism. Above 1642°C, the data fit the equation $D = (1.73^{+0.7}_{-0.4}) \times 10^{2} \exp[-(97753 \pm 1816)/RT]$. (auth)

27356 EFFECT OF STRUCTURAL STATE AND ELEMENTS OF THE CERIUM SUBGROUP OF ELEMENTS ON THE HEAT RESISTANCE OF Cr. Tavadze, F. N.; Rudol, A. P.; Mikadze, O. I. (Inst. of Metal Physics, Kiev). Metallofizika; No. 45, 27-31(1973). (In Russian).

The sintering stability of Cr electrolytically refined (99.9%) in hydrogen in different structural states at temperatures of 1000, 1100, and 1225°C for 200 h and the effect of addition of rare earth metals of the cerium subgroup were studied. It was shown that the heat resistance of Cr and its alloys depends on variations in structure obtained by different methods of melting (zonal by successive fusion or casting) or heat deformation. The addition of up to 1% rare earth metals improved the heat resistance of Cr. (tr-auth)

27357 EFFECT OF SMALL ADDITIONS OF ALLOYING ELEMENTS ON THE MECHANICAL PROPERTIES OF ELECTRON-BEAM-MELTED Mo. Movchan, B. A.; Malashenko, I. S.; Vashchilo, N. P. (Inst. of Electro-Welding, Kiev). Metallofizika; No. 45, 41-46(1973). (In Russian).

The physico-mechanical properties of binary alloys of Mo containing micro additions of Hf, HfC, Ni, and V after electron-beam melting and annealing of the hot-rolled rod were determined. It was shown that HfC (0.15 wt %) increases the high-temperature resistance of the alloys and decreases their cold-brittleness temperature. 0.01 to 0.03% Ni plasticizes a solid solution of Mo and decreases the temperature sensitivity of the creep and strength limits. Mo alloys with 0.05 to 0.2% V have a low threshold of cold brittleness in the electron-beam-melted state, which is due to the refining effect of the addition and removal of impurities from the grain boundaries. (tr-auth)

27358 MOLYBDENUM AND TUNGSTEN FIBERS AS STRENGTHENING AGENTS OF HIGH-HEAT-STRENGTH COMPOSITE MATERIALS. Kobal, A. D.; Natapov, E. B.; Lezhenko, G. G.; Sein, V. I.; Shegai, A. A.; Shmakov, A. M. (Zaporozhe Machine-Construction Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 153-155(1973). (In Russian).

Wires 0.5 mm dia were used for reinforcing. The matrix was a high nickel alloy EI 435, and the volume content of wire was 24%. Results of tensile strength testing show that the tensile strength of a composite material EI 435 + 30% Mo + W wire at a temperature of 1100°C in the initial state and after annealing 500 h was 11 to 14 kg/mm^2. Another composite material of EI 435 plus 24% tungsten wire showed an experimental tensile

strength of 19 kg/mm² at 1100°C. Other composite materials gave tensile strengths of 22.2, 16.4, and 17 kg/mm² at 1100°C. If the strength of the matrix material at 1100°C is neglected, the strength is attributed mainly to the strength of the fiber. High-strength Mo wire showed the most promise as a reinforcing agent. (SJR)

27359 EFFECT OF CRYSTALLIZATION CONDITIONS ON THE STRUCTURE AND PHASE COMPOSITION OF Ni–Mo ALLOYS. Varich, N. I.; Petrunina, A. N. (Dnepropetrovsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 149-150(1973). (In Russian).

Alloys containing 22 to 44 at. % Mo were crystallized from melts having temperature of 1400, 1900, and 2000°C at a cooling rate of 30, 10^4 to 10^5, and 10^7 to 10^8 deg/s. By cooling at a rate of 10^7 to 10^8 deg/s it is possible to suppress the separation of Mo Ni_3 and $MoNi_4$ phases, and attain a higher degree of supersaturation of Mo in the nickel base. In a melt with a content of 34.8 at. % Mo crystallized from a liquid (from 1900°C), along with a metastable α-solution it was possible to detect a dispersed precipitate of an intermediate metastable γ'-phase. On increasing the content of Mo to 37.4 at. %, the amount of γ'-phase increases. This phase has a free crystal lattice with a = 4.255 kX in a melt with a content of 34.8 at. % Mo. The interplanar distances are tabulated. The γ'-phase is stable on heating to 600°C. On holding 2 h at 600°C in a furnace with a protective atmosphere, the γ'-phase transforms into a hexagonal, dense-packed phase close in composition to $MoNi_3$. At concentrations of 22 to 28 at. % Mo in films cooled at a rate of 10^7 to 10^8 deg/s, breakdown of the supersaturated solid solution takes place on heating to 650°C for 1 h. At a temperature of 700°C for 30 minutes (in a furnace with a protective atmosphere), the compound $MoNi_4$ separates out of melts containing 22 to 28 at. % Mo. (SJR)

27360 EFFECT OF CARBON ON THE PROPERTIES OF NIOBIUM ALLOYS (NB 10 TZTS). Prokoshkin, D. A.; Vasil'eva, E. V.; Markova, S. A.; Chizhov, I. N. (Moscow Higher Technical School). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 138-143 (1973). (In Russian).

The chemical composition of one niobium alloy (NB 10 TZTS) was: Nb base, 9.82% W, 2.8% Ti, 1.6% Zr, and 0.04% C. The other niobium alloy (NB 10 TZTSU) had the composition: Nb base, 9.48% W, 3.25% Ti, 2.05% Zr, and 0.10% C. W is added to strengthen the solid solution, and alloying with Ti, Zr, and C was undertaken in order to create refractory dispersed carbide phases. The microstructure of hot-pressed samples show a typical fiber structure with alternating deformed and recrystallized grain sections. Grain size tends to be smaller with higher carbon content. On the basis of metallographic analysis, change in hardness, and a study of the fine structure of the alloys after various annealing treatments, it can be concluded that the recrystallization temperature of the NB 10 TZTS alloy is 1300°C, which increases to 1400°C for the NB 10 TZTSU alloy. The alloy with higher carbon content showed a 69% increase in hardness on quenching from 1600°C, and aging for 300 hr at 1100°C, while the alloy with lower carbon content showed a hardness increase of only 29% with the same thermal treatment. The alloy with higher carbon content showed an increase in strength and better resistance to creep at higher temperatures. (SJR)

27361 STATISTICAL REGULARITIES OF THE EFFECT OF ALLOYING ELEMENTS ON THE MECHANICAL PROPERTIES OF Ti–Al–Mo–V ALLOYS (TYPE VT 16). Dolzhanskii, Yu. M.; Moiseev, V. N.; Sibileva, L. I.; Terent'eva, L. N. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 132-137(1973). (In Russian).

The effect of Al, Mo, and V content on tensile and shear strength is investigated on annealed and quenched aged alloys which contained 0.8 to 3% Al, 1.8 to 5.5% Mo, and 2 to 6.0% V. The data were treated statistically to determine optimum strength properties of the alloy as a function of composition of alloying elements and thermal treatment of the alloy. For the preparation of reinforced articles which must operate with resistance to shear, it is recommended that the alloy have the following average composition: 2.0% Al, 6.5% Mo, 4.0% V, rest titanium or 3.5% Al, 5.0% Mo, 4% V, rest titanium. These alloys in the annealed state have a shear strength of 64 kg/m² with a plasticity of >60%. For articles operating under tensile stress, an alloy of the following composition is recommended: 2.5% Al, 4.5% Mo, 4.5% V. This alloy is strengthened thermally by annealing 2 h at 780°C, and quenching 2 h in water, and aging 8 h at 570°C. This alloy has a tensile strength of >110 kg/mm² with a plasticity of 60%. For articles with a tensile strength of >125 kg/mm² and a plasticity of 55-58%, this alloy should be quenched 1 h from 780°C in water and aged 16 h at 500°C. (SJR)

27362 DILATOMETRIC STUDY OF TRANSFORMATIONS IN THE Ti–V AND Ti–Al–V ALLOY SYSTEM. Lyasotskaya, V. S.; Kolachev, B. A.; Sovalova, E. G. (Moscow Aviation Technology Inst.). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 127-131 (1973). (In Russian).

A study was carried out on binary titanium alloys containing 4, 10, 16, and 25% V and having various structures (α', α'', β + ω and β) after quenching and from the β-region, and also on ternary alloys with the same vanadium contents but with various aluminum contents (3 and 6%). Besides dilatometric analysis, x-ray and metallographic analyses were also used. After annealing the structure of all alloys was represented by α and β phases, and after quenching by the following phases: α' (Ti + 4% V, Ti + 3% Al + 4% V, Ti + 6% Al + 4% V); α'' (Ti + 10% V, Ti + 3% Al + 10% V, Ti + 6% Al + 10% V); β + ω (Ti + 16% V), β (Ti + 25% V, Ti + 3% Al + 16% V, Ti + 3% Al + 25% V, Ti + 6% Al + 16% V, Ti + 6% Al + 25% V). In binary alloys of the Ti–V system breakdown of martensite α' is not accompanied by noticeable volumetric effects, but breakdown of martensite α'' is accompanied by a contraction effect at temperatures above 400°C. Alloying of martensite alloys in the Ti–V + 3% Al system leads to an increase in volumetric effects accompanying the breakdown of martensite α' and α'' on heating, while alloying with 6% Al leads to almost complete disappearance of these volumetric effects. These effects indicate the breakdown of an unstable β-solution in Ti–V alloys, and indicate that essentially different processes are taking place in these alloys above and below 280°C. Aluminum decreases the volumetric effects caused by the formation and transformation of an ω phase. In the presence of aluminum, a significant contraction effect is observed at temperatures above 500°C which is associated with a redistribution of aluminum between the α and β phases. (SJR)

27363 THERMODYNAMICS OF BERYLLIUM–YTTRIUM ALLOYS. Butorov, V. P.; Nichkov, I. F.; Novikov, E. A.; Raspopin, S. P.; Shtol'ts, A. K. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 86-89 (1973). (In Russian).

Emf's of Y–Be alloys were measured at Y contents of 4.1 to 40.8 wt %. X-ray analysis of the alloys showed the existence of two phases: an intermetallic compound YBe_{13} and pure beryllium. The emf as a function of temperature is given by the equation: emf = $1.119 - 0.574 \times 10^{-3}$ T ± 0.008 volts (T = 680 to 824°C). Activity coefficients are given for yttrium metal in the alloy at 700, 750, and 800°C. A large negative deviation from Raoult's law in the Y–Be system indicates a strong interaction between Y and Be. The Y activity is given by the equation: $\lg a_Y = 8.679 - (16919/T)$. The partial molar Gibbs free energy of Y in the alloy is given by the equation: $\Delta\bar{G}_Y = -77421 + 39.71$ T cal/g-atom. X-ray analysis of the alloys showed the presence of two phases: an intermetallic compound YBe_{13} and pure beryllium. (SJR)

27364 DISTRIBUTION OF CHROMIUM, MANGANESE, AND ZIRCONIUM IN ALLOYS OF COPPER–IRON–ALUMINUM. Ivanova, S. I.; Myuller, N. N.; Pinchuk, P. A. Tsvetn. Metal.; No. 12, 53-54(Dec 1973). (In Russian).

By x-ray microscopic analysis it is established that in cast alloys of Cu–Fe–Al in the Cu matrix there is from 7 to 12% Al, 1.6 to 3.0% Fe, and approximately half of the Mn introduced in the alloy. In alloys with additions of Cr, a region enriched in Cr is observed in the Cu matrix, but almost all the Cr is found in the Fe phase containing from 1.5 to 14.4% Cu and from 10.3 to 13.0% Al. (tr-auth)

27365 DEFECT FORMATION IN V_2O_5. Bolzhenskii, D. S.; Pashkovskii, M. V.; Fedorko, V. F. (Lvov State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 9, 1404-1407(Sep 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 9, 1581-1584(Sep 1973).

Variation of the conductivity of single crystals of V_2O_5 with annealing time at constant temperature was investigated. The increase in conductivity is due to the formation of oxygen vacancies. On the basis of the calculated value of the order of reaction, γ = 0.5, it is supposed that the formation of an oxygen vacancy involves two stages. The energy of formation of an oxygen vacancy in V_2O_5 is calculated to be 0.84 eV. (34 references) (auth)

27366 THEORY OF THE THERMODYNAMIC PROPERTIES OF LIQUID METALS. Jones, H. D. (Sandia Labs., Livermore, CA). AT(29-1)-789. Phys. Rev., A; 8: No. 6, 3215-3226(Dec 1973).

Thermodynamic properties of the liquid metals Li, Na, K, and Al are calculated using a pseudopotential model together with an application of thermodynamic perturbation theory based on the Gibbs-Bogoliubov inequality. The theory is used to predict many properties associated with the melting phenomenon, for example, the melting temperature and density as a function of temperature, and the latent heat of fusion. It is found that the theory reproduces

the trend in latent heats between the alkali metals, in contrast to previous work, although quantitative agreement with experiment is no better than has been obtained before. The theory is also applied to the prediction of thermodynamic properties on and away from the melting curve; in particular, the specific heat and velocity of sound of sodium are calculated over a wide range of temperature. Agreement with experiment is found to be good. (auth)

27367 INVESTIGATION OF THE INFLUENCE OF MICRO-ADDITIONS OF NICKEL ON THE MECHANICAL PROPERTIES OF MOLYBDENUM AND ITS CARBON ALLOYS. Malashenko, I. S.; Statkevich, V. N.; Shchukin, A. A. (Inst. of Electricity, Kiev). Probl. Prochnosti; 5: 51-55(Sep 1973). (In Russian).

The strength and ductility of pure molybdenum and of Mo–Ni and Mo–Ni–C alloys are studied as a function of the temperature to gain insight into the action of nickel in molybdenum solid solutions at temperatures corresponding to strain aging. It is found that molybdenum alloys containing 0.01 to 0.06 wt % Ni are susceptible to dynamic aging in the range between 700 and 800°C. This is associated with an increase in the carbon concentration in the molybdenum solid solution. High-temperature annealing (above 1400°C) leads to decomposition of the carbon solid solution in molybdenum alloyed with nickel. (IAA)

Radiation Effects

Refer also to abstracts 27391 and 28661.

27368 (CEA-N-1664) IRRADIATION OF COPPER WHISKERS UNDER STRESS. Bounaud, J. Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Oct 1973. 38p. (In French). Dep. NTIS (U. S. Sales Only) $4.00.

Thesis. Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

When a monocrystal is irradiated under stress, plastic deformation occurs. At high temperatures, this creep is due to the migration of defects created by irradiation. At low temperatures, the only mechanism possible is the orientated nucleation of dislocation loops. Theoretical analysis of this mechanism together with measurements of the deformation enabled information to be obtained on the size of the dislocation loop nuclei. Copper whiskers were manufactured and subsequently irradiated under stress. In this way, the orientated nucleating mechanism was firmly established. The experimental and theoretical results are in good agreement and demonstrate that 3 interstitials in the nucleus of an interstitial loop and 5 vacancies in the nucleus of a vacancy loop constitute what are to be considered reasonably sized nuclei. (FR)

27369 (FRNC-TH-411) ANELASTIC PHENOMENA IN IRRADIATED AND WORK-HARDENED REFRACTORY METALS. Pichon, R. (Grenoble-1 Univ., 38 (France)). 1973. 189p. (In French). Dep. NTIS (U.S. Sales Only) $11.50.

Thesis.

The physical properties of point defects in Zr and Ti were studied using internal friction measurements. These measurements give, by themselves, the symmetry and enable the defects to be identified. The utilization of these results in conjunction with those obtained from electrical resistivity methods and elastic modulus methods led to the development of a coherent model for the defects. (FR)

27370 (ORNL-TM-4426, pp 67-69) SIMULATION OF NEUTRON DAMAGE BY ION BOMBARDMENT. Stiegler, J. O. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22–23, 1973.

Niobium and vanadium samples are being irradiated under high vacuum conditions with helium and hydrogen ions to simulate transmutation conditions that will occur in controlled fusion reactor walls. It is planned to establish quantitative relationships between ion bombardment and fast neutron irradiation and to study the effects of resulting transmutation products on metallurgical properties. (SFL)

27371 (ORNL-TM-4495) AUGER ELECTRON SPECTROSCOPY OF FRACTURE SURFACES IN IRRADIATED TYPE 304 STAINLESS STEEL. Bloom, E. E.; Clausing, R. E. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 22p. Dep. NTIS $3.25.

Surfaces were studied in type 304 stainless steel fractured after irradiation at 370°C to 1.4–10 × 10^{22} n/cm^2. The irradiated samples failed primarily along grain boundaries, although in some cases areas of ductile transgranular fracture were also present. He release during fracture was monitored with a residual gas analyzer; its concentration at the boundaries was approximately proportional to the fast neutron fluence to which the samples were irradiated, being about 0.08 helium atoms per grain boundary site at 1 × 10^{23} n/cm^2. Phosphorus was more concentrated at grain boundaries than on ductile fracture surfaces. Sulfur segregated to surfaces during and after the fracture, suggesting that it could segregate to grain boundaries. Grain boundary fracture surfaces of irradiated samples were depleted in Cr and enriched in Fe and Ni compared with ductile fractures of unirradiated samples broken at the same temperature. (auth)

27372 (ORO-3912-22) COMPUTER EXPERIMENT STUDIES ON MECHANISMS FOR IRRADIATION INDUCED DEFECT PRODUCTION AND ANNEALING PROCESSES. Progress Report, April 1, 1973–June 30, 1973. Beeler, J. R. Jr. (North Carolina State Univ., Raleigh (USA)). Jul 1973. Contract AT(40-1)-3912. 19p. Dep. NTIS $3.00.

Work was devoted to three projects: 1) analysis of energy deposition and displacement production in collision cascades produced by 4-MeV Fe atom bombardment of fcc Fe; 2) annealing of the defect state initially produced by 4-MeV Fe atom bombardment of Fe; and 3) computation of the displacement threshold energy directional dependence in fcc Fe. (3 tables, 8 figures) (DLC)

27373 (ORO-3912-26) COMPUTER EXPERIMENT STUDIES ON MECHANISMS FOR IRRADIATION INDUCED DEFECT PRODUCTION AND ANNEALING PROCESSES. Progress Report, July 1, 1972–March 1, 1974. Beeler, J. R. Jr. (North Carolina State Univ., Raleigh (USA)). Mar 1974. Contract AT(40-1)-3912. 25p. Dep. NTIS $4.25.

Simulation of 4-MeV Fe atom induced cascades in fcc Fe indicates that the damage energy is transported in both the forward and backward directions, leading to a flatter damage energy density distribution. Computer experiments on a direction-dependent displacement energy threshold for fcc Fe were performed for 25 different directions, providing a self-consistent basis for primary and secondary displacement models in dpa calculations. Simulation of 1-MeV HVEM electron irradiation and annealing produced interstitial dislocation loops and large vacancy clusters. Annealing simulation of overlapping subspikes in 4-MeV displacement spikes in fcc Fe produced interstitial dislocation loops during short-term annealing, with the subspike energies ranging from 5 to 30 keV. Annealing simulation of isolated 20-30-keV spikes did not produce interstitial dislocation loops during short-term annealing. Ion bombardment and neutron irradiations are compared. The dislocation loop problem is considered; it can be solved approximately using the GLOB program. (DLC)

27374 (RISO-287) STUDY OF IRRADIATION INDUCED VOIDS IN DISPERSION HARDENED STAINLESS STEEL. Singh, B. N. (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar 1973. 41p. Dep. NTIS (U. S. Sales Only) $4.25.

An experimental stainless steel with ultrafine grains and with and without dispersions of fine oxide particles was irradiated with 1-MeV electrons in a high voltage electron microscope; samples with and without implanted helium were irradiated. It is shown that the nucleation of voids and the resultant volume swelling are severely reduced by decreasing the size of the grain under irradiation. A further reduction in swelling is obtained in the specimens containing dispersions of oxide particles. The implanted helium atoms increase the void number density in large grains but have very little effect in the small ones. Results are consistent with a model based on migration of point defects to grain boundaries giving rise to a grain size-dependent vacancy concentration in the grain interior within a certain grain size range. It is concluded that the grain refinement and dispersion of small particles lead to a highly swelling-resistant material which may be an attractive candidate material for the fast breeder reactor. (29 figures, 27 references) (auth)

27375 (UCID-16408) EXPERIMENTS ON THE BOMBARDMENT OF METALLIC SURFACES WITH 15-keV DEUTERONS. Hunt, A. L.; Damm, C. C.; Goodman, R. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Dec 1973. Contract W-7405-eng-48. 77p. Dep. NTIS $6.00.

These data were taken in the period 1962 to 1964 in support of the high-energy plasma experiments in the Livermore controlled thermonuclear program. Because of a recent extension of interest in the impurity problem in toroidal systems the information is being distributed outside of the Lawrence Livermore Laboratory. Information is included on effects of deuteron bombardment on stainless steel, Cu, W, and Ti. (JRD)

27376 EFFECT OF STRESS CONCENTRATION ON MECHANICAL PROPERTIES OF Mo SHEET WITH PROTECTIVE

COATINGS. Zelenyuk, E. E.; Sosnovskii, L. A. (Inst. of the Strength of Materials, Kiev). Strength Mater. (USSR) (Engl. Transl.); 5: No. 3, 356-360(Mar 1973).

Translated from Probl. Prochnosti; 5: No. 3, 90-94(Mar 1973).

Results of the investigations show that under conditions of brief static loading molybdenum sheet of grade MCh-II is almost insensitive to stress concentrations (for the selected types of concentrators). The presence of a diffusion protective coating leads to a considerable decrease in the ductility of the material over the whole investigated range of temperatures and to a decrease in its strength at temperatures below the coating deposition temperature. It was established that the strength of specimens with protective coatings in the presence of stress concentrators is higher than the strength of smooth specimens with the same coatings. (auth)

27377 STABILITY AND PLASTICITY OF FINE POLYCRYSTALLINE FILAMENTS OF W AND Cu. Ashanin, V. S.; Garbev, R. L; Rubukhin, V. G.; Fedorova, L. I. (Kharkov Automobile-Highway Inst.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 11, 2448-2450(Nov 1973). (In Russian).

The results of the study of the characteristics of the size effect in polycrystalline filaments of W and Cu are reported. The dependence of the tensile strength on the filament diameter is shown for both metals. The relations of the dimensions of the crystalline grain and the diameter of the electrolytically thinned filament with the size effect is studied and the results show that an increase of strength is observed when the wire diameter becomes less than the grain size. (JSR)

27378 MINIATURE URANIUM FUEL PLATES COOLED BY LIQUID HELIUM FOR IRRADIATION DAMAGE STUDIES. Southern, A. L. (Oak Ridge National Lab., TN); Coltman, R. R. Jr.; Klabunde, C. E.; Hemmerich, J. L. Advan. Cryog. Eng.; 18: 92-95(1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

The design of an experimental apparatus is described for irradiation of miniature U fuel plates in the sample chamber of a cryostat where helium is condensed to liquid. The fission plate assembly is described along with fission plates, samples and holders, and operating experience. (JRD)

27379 DEFECT RETENTION IN COPPER DURING ELECTRON IRRADIATION AT 80°K. Thompson, L.; Youngblood, G.; Sosin, A. (Univ. of Utah, Salt Lake City). Radiat. Eff.; 20: No. 1-2, 111-134(1973).

Electron irradiation damage in copper at 80°K is analyzed by a reciprocal damage rate approach and by a method relating normalized damage and normalized fluence. The latter is more sensitive to changes in effective trapping concentrations; the unsaturable trap model has not been found to strictly hold for any sample irradiated in these experiments or described in the literature. More importantly, the increase in relative trapping radius with respect to the nucleation of interstitials varies at least by a factor of 30 according to sample pre-irradiation treatment. These results and those of stage II irradiations provide information regarding the relative size and nature of trapping centers. Trapping probabilities based upon interstitial diffusion in both the correlated and uncorrelated "stages" I_D and I_E, rather than I_E alone, predict some nonlinear reciprocal damage rate curves—even for constant trapping radii—due to the increasing encroachment of stage I_E into I_D during irradiation. Values of initial damage rates and their concentration dependence are also predicted by this calculation. Use of these trapping probabilities in an integral equation for normalized damage allows a determination of effective trapping concentration from a single damage-fluence data point, and has been found to accurately describe irradiations over 3 orders of normalized fluence magnitude and of samples differing by 4 orders of magnitude in impurity concentration. The concentration dependence of the effective uncorrelated interstitial production factor is found by comparison of this approach with one involving I_E diffusion alone. Irradiation data at early normalized fluence and initial damage rate data suggest the absence of residual interstitial sink concentrations and suggest that interstitial specific resistivities decrease slightly upon trapping. (auth)

27380 FIELD ION MICROSCOPE STUDIES OF 400 eV ARGON ION BOMBARDMENT DAMAGE IN TUNGSTEN. Gregov, B.; Lawson, R. P. W. (Univ. of Alberta). Fizika (Zagreb); 5: No. 4, 165-169(Dec 1973).

Bombardment of tungsten was carried out at 63°K at a background pressure in the 10^{-11} torr range with 400-eV Ar^+ ions. Clusters of vacancies and interstitials were observed. After field evaporation of a few atomic layers, damage could still be observed on the newly exposed surface, indicating damage produced inside the specimen. Evidence for an assisted focusing event in the direction of the [100]-zone is presented. (auth)

27381 CHARGE EXCHANGE TO THE CONTINUUM FOR LIGHT IONS IN SOLIDS. Dettmann, K.; Harrison, K. G.; Lucas, M. W. (Sussex Univ., Brighton, Eng.). J. Phys., B (London); 7: No. 2, 269-287(1 Feb 1974).

Electron capture into ionized states of fast ions (H^+, H_2^+, He^+) in carbon and gold foils is investigated. Velocity spectra of ejected electrons are measured in the forward direction and a characteristic cusp-shaped peak is found for electrons ejected with velocity equal to that of the incoming ions. The spectra are interpreted by a theory of charge exchange to the continuum, based on an atomic physics ion-atom collision model. As with proper charge exchange, a second order Born approximation is necessary to calculate the high energy cross sections. (auth)

27382 MEASUREMENT OF THE ANGULAR CORRELATION OF POSITRON ANNIHILATION RADIATION USING A Ge(Li) DETECTOR. Singru, R. M. (Stichting Reactor Centrum Nederland, Petten). J. Phys. Chem. Solids; 35: No. 1, 33-35(Jan 1974).

The use of a Ge(Li) detector as one of the radiation detectors in a long slit angular correlation measurement of the annihilation radiation is described. The measurement yields information similar to that obtained by point slit or spark chamber geometry. The results for a copper single crystal are reported. (auth)

27383 RADIATION HARDENING IN ZIRCALOY-2. Snowden, K. U.; Veevers, K. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Radiat. Eff.; 20: No. 3, 169-174(Nov 1973).

Annealed Zircaloy-2 was exposed to fast neutron fluences in the range 0.46 to 6.71×10^{19} nvt, $E \geq 1$ MeV, at temperatures of up to 450°C. The level of radiation hardening, as measured by the change in yield stress after irradiation, increased with irradiation temperature at least up to 380°C. Post-irradiation annealing treatments showed that radiation anneal hardening occurred after irradiation at temperatures up to 325°C. After irradiation at 375°C, annealing treatments did not produce a further increase in the yield stress above that produced by the irradiation; however, the radiation hardening persisted to 450°C. The uniform strain tended to decrease as the amount of radiation anneal hardening increased and as the fast neutron fluence increased above $\sim 5 \times 10^{18}$ nvt, $E \geq 1$ MeV. The effects of irradiation temperature and post-irradiation annealing on the yield stress and on uniform strain are explained in terms of the strengthening of radiation damage defect clusters and their increased effectiveness to impede dislocation movement. (auth)

27384 INTERNAL FRICTION IN Zr IRRADIATED BY NEUTRONS AT 77°K. Pichon, R.; Bisogni, E.; Moser, P. (Centre d'Etudes Nucleaires, Grenoble, France). Radiat. Eff.; 20: No. 3, 159-168(Nov 1973). (In French).

Seven internal friction peaks are found in Zr after neutron irradiation at 77°K. The first and second peaks correspond to the free interstitial reorientation and migration at the end of stage I. The elastic dipole created by this interstitial is monoclinic and its complex reorientation gives rise to the "frozen free split" phenomena predicted by Nowick (Anelastic Relaxation in Crystalline Solids (Academic Press, New York, 1972)). This defect disappears by correlated and uncorrelated annihilation after tridimensional migration at the end of stage I. The other peaks correspond either to intrinsic phenomena (interstitial loops, divacancies) or extrinsic processes involving impurity or dislocation. These peaks are not strongly affected by impurities. (auth)

27385 MULTI-FAULTED DISLOCATION LOOPS IN ELECTRON BOMBARDED Al. Wolfenden, A. (Oak Ridge National Lab., TN). J. Phys., D (London); 7: No. 3, 295-305(1972).

The high-voltage (650 kV) electron microscope was used to introduce and observe multi-faulted dislocation loops in Al. A wide variety of different loop configurations, including double and triple-layer defects, was encountered in He-preinjected Al and compared with that from quenching investigations by other authors. The observation that faulted dislocation loops formed under a wider range of irradiation temperatures and with a wider variety of configurations in Al previously doped with a few ppM He than they did in uninjected material, suggests that He can influence the process of fault formation. (auth)

27386 RADIATION-ENHANCED DIFFUSION OF BORON IN GERMANIUM DURING ION IMPLANTATION. Guseva, M. I.; Mansurova, A. N. (Inst. of Atomic Energy, Moscow). Radiat. Eff.; 20: No. 3, 207-210(Nov 1973).

An effect of radiation-enhanced diffusion during boron ion implantation into 200 to 500°C germanium substrates was found. The boron-enhanced diffusion coefficient is independent of the temperature over the range 200 to 500°C during ion implantation. It depends upon the dose rate of the incident ions and its value corresponds to the thermal diffusion of boron in germanium at 800°C. (auth)

Other Materials

Refer also to abstracts 26666, 27309, 27322, 27381, 28913, 28922, and 28926.

27387 (BNWL-259) ROVER GRAPHITE STUDIES QUARTERLY PROGRESS REPORT, JANUARY–MARCH 1966. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1966. Contract AT(45-1)-1830. 19p. Dep. NTIS $3.00.

Declassified 28 Aug 1973.

Optical microscopy of untested and hot-gas-tested Rover unfueled and fueled elements was used to study coating adherence and porosity development. Application of microradiography to the examination of Rover elements was evaluated. Nitridation of Nb carbide was studied briefly. (DLC)

27388 (BNWL-596) MICRORADIOGRAPHY OF POROSITY IN ROVER FUEL ELEMENTS. Bunnell, L. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1968. 37p. Dep. NTIS $4.00.

Declassified 28 Aug 1973.

Radiographic detection of a vacuum-impregnated stain was used to reveal pore networks in as-manufactured and hot-gas tested ROVER elements from WANL and Y-12. Access of the stain was controlled to simulate hydrogen access to bore-connected pores in these elements. Pore networks revealed by this method in untested samples were most prevalent at positions corresponding to the greatest porosity in tested elements. The study also revealed details of fuel-bead migration, empty fuel-bead cores, and associated pore networks. (21 figures) (auth)

27389 (BNWL-737) MICROAUTORADIOGRAPHIC CHARACTERIZATION OF ROVER BORE COATING INTERFACES. Bunnell, L. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1968. Contract AT(45-1)-1830. 21p. Dep. NTIS $3.25.

Declassified 28 Aug 1973.

In an effort to understand the anomalous nonadherence of the NbC bore coatings on fueled ROVER elements, a modified microautoradiographic method was used to reveal the U distribution at the coating/graphite interface. The method was used on elements manufactured with a reduced U content at the interface. Correlation between alpha tracks and the surrounding microstructure was excellent. Observations are consistent with the concept that uranium is responsible for an accelerated attack on the graphite during coating, although this is not explicitly proven. The presence of U in amounts below the detection limit of the method used is associated with tightly adherent NbC coatings. (auth)

27390 (CEA-CONF-2524) BEHAVIOUR OF PYROCARBON FUEL COATINGS AT HIGH FAST NEUTRON DOSE. Janvier, J. C.; Moreau, C.; Voice, E. H. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). 25 Jul 1973. 10p. (CONF-731004-8). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on nuclear fuel performance; London, UK (15 Oct 1973).

Fast reactors can be used successfully for the accelerated testing of pyrocarbon coatings on fuel particles with respect to fast neutron damage effects. The comparisons correlate qualitatively with similar tests in thermal reactors. Results show improved irradiation performance in triplex-particles of pyrocarbon coatings from the higher hydrocarbons (propene and butane) over those from methane. At low temperatures (~800°C), methane coatings have behaved well up to 2.9×10^{21} n cm^{-2} EDN but fail rapidly and extensively above: at 1200°C the limit is around 2.4×10^{21} n cm^{-2} EDN. Both butane and propene-derived coatings in triplex systems can survive without damage beyond 6.3×10^{21} and 1200°C when fabricated without laminations or internal gradients. Inhomogeneities in most varieties in both Corail VI and VII prevented any distinction between propene and butane. The density of the outer pyrocarbon must not be too high (not greater than 1.85 g cm^{-3}) nor the density of the inner layer too low (not less than 1.80 g cm^{-3}). The optimum for the butane and propene coatings seems to be between 1.70 and 1.75 g cm^{-3} for the outer layer, associated with a low modulus, and 1.80 to 1.85 g cm^{-3} for the inner. The inner pyrocarbon must remain firmly adhering to the inner surface of the silicon carbide layer throughout life. Although in Corail VI separation and cracking of the inner pyrocarbon did not necessarily cause the exterior layers (SiC and Pyc) to fail, rapid failure would follow in a thermal reactor generating high burnup. (DLC)

27391 (KFK-1864) UO_2–PuO_2 FUEL PIN TREFOIL IRRADIATION DFR-304. Evaluation of the Post-Irradiation Examination Results. Ehrlich, K.; Goetzmann, O.; Hoffmann, H.; Kleykamp, H.; Zimmermann, H.; Dienst, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Jan 1974. 95p. (In German). Dep. NTIS (U. S. Sales Only) $7.75.

Three UO_2–PuO_2 fuel pins were irradiated in a trefoil cooled by flowing NaK. Irradiation was performed in the fast neutron flux of DFR at rod powers between 380 W/cm (fuel end) and 500 W/cm (maximum) to a maximum burnup of 6.3 at. % (U + Pu). The maximum fuel temperature was possibly above 2800°C in the beginning and about 2500°C after formation of the central hole. The cladding ID temperature was between 320 and 700°C. Fission gases were measured in three steps as released gas, gas retained in large bubbles, and gas retained in small bubbles and crystal lattice sites. A rather high fission yield of 0.32 gas atoms per fission was determined. The retained fission gas distribution over the fuel length resulted in a strong temperature dependence of fission gas retention at low fuel temperature <1300°C, which is reason for the introduction of a low temperature zone <1000°C in a formula for the fission gas retention in 3 fuel temperature zones. The temperature limit of columnar grain growth was found to be at 1680 to 1760°C fuel irradiation temperature, in accordance with the limit for healing of radial fuel cracks. The temperature limit for equiaxed grain growth was about 1300°C. The void volume distribution was examined by measuring gap widths, cracks widths, central hole diameters, and porosity. Porosity measurements were compared to SATURN computations. The strongest deviation resulted from the reduction of the sintered porosity in the outer, relatively cool fuel zone to an amount of only 3 to 4%. However, the remaining porosity is superposed by local accumulation of new pores, probably formed by healing of tangential cracks. New effects occurred which seem to be caused by the fuel sticking to the cladding and by clad swelling in the fast neutron flux. Electron microprobe analysis was applied to examine Pu redistribution, fission-product compound composition and distribution, and cladding corrosion. Redistribution in the radial fuel temperature gradient resulted in Pu enrichment around the central void amounting to 22% PuO_2 (compared to 20% original) at the hot bottom end of the fuel column. At the bottom end of the central hole, multiphase Ba–Mo–Nb–V–oxide precipitates were observed. The radial distribution of Mo was measured in fuel solid solution. The Mo concentration was below 0.3%. By examining the radial distribution of the Mo–Tc–Ru–Rh–Pd precipitates, a maximum of the precipitation density was found in the cooler part of the columnar grain zone. The composition in those precipitates was measured over the fuel radius; Mo was between 31 and 36%. Tellurides, Iodides, and Pd-containing phases with volatile fission products (Sn, Sb, Te) occurred preferably in the porous outer fuel zone and in the gap. Cs- and Ba-molybdate were observed all over the gap. However, Cs-chromate, -uranate and -plutonate had been formed only in the cooler part of the fuel pin in the gap and in the fuel near the surface. The fuel/cladding reaction was most strongly marked in the vicinity of the fuel/blanket contact, which possibly yields a locally accelerated oxygen transport from the central void to the cladding. In the cladding grain boundaries, the fission products Cs, Mo, Pd, Te and a Cr-enrichment could be found. No corrosion attack by the NaK coolant could be indicated on the cladding surface. Cross sections showed considerable penetration depths of the cladding inside attack only above 550°C (cladding ID temperature). The strongest attack (in the vicinity of the fuel/cladding contact) amounted to 100 to 110 μm. However, the maximum penetration depth did not face the fuel/cladding boundary, and it is concluded that the oxide compounds produced by the fuel/cladding reaction might be unstable at very high cladding temperature (≥700°C). The reaction resulted in a grain boundary attack, by which the individual grains were loosened from the cladding structure. The cladding temperatures attached to certain penetration depths of cladding inside attack were about 50°C higher than those from the irradiation test Mol 7A. A 16 Cr–13Ni–niobium stabilized stainless steel (type 1.4988) was irradiated as fuel pin cladding at 300 to 650°C and 3.3 to 4.0 10^{22} n/cm^2 (E > 0.1 MeV) was achieved. Swelling behavior was studied by transmission electron microscopy, immersion density, and diametral changes. Void formation was observed in the temperature range 360 to 610°C. Void concentration values at lower temperatures (<480°C) are comparable to those cited for the unstabilized stainless steel AISI 304 and 316; however, they decrease more strongly with irradiation temperatures. The mean and maximum diameters show a pronounced maximum at about 530°C. The decrease of the void diameters at higher temperatures can be explained by the nature of the cavities observed. Annealing of specimens irradiated at 610°C revealed a bubble or a mixed void-bubble character for these cavities. Swelling in type 1.4988 was found to be lower than that reported for AISI 316 at higher temperatures, possibly owing to the small neutron doses in this temperature region so that the threshold level for void formation

had not yet been reached. The measured diameter changes of the pins at T ≥610°C cannot be explained by void formation. (10 tables, 44 figures) (DLC)

27392 (N-73-26583-7) INVESTIGATION INTO THE HIGH-TEMPERATURE STRENGTH DEGRADATION OF FIBER REINFORCED RESIN COMPOSITE DURING AMBIENT AGING. Final Report, July 1971–June 1973. Hertz, J. (General Dynamics/Convair, San Diego, Calif. (USA)). Jun 1973. Contract NAS8-27435. 175p. (NASA-CR-124290). NTIS $10.75.

An investigation was conducted to determine the cause for the reduction in high temperature strength properties of graphite- and boron-reinforced epoxy composites following aging in room temperature environments. The types of resins tested are identified. The test procedures are explained. Tables of data and graphs are provided to show the effects on various materials. (GRA)

27393 VARIATION OF THE DEFECTS ON CHANGE OF THE IRRADIATION TEMPERATURE IN LiF. Kazumata, Y. (Japan Atomic Energy Research Inst., Tokai). J. Phys. Soc. Jap.; 35: No. 5, 1560(Nov 1973).

Variations in concentration of M and F_3^+ centers in LiF crystals irradiated at different temperature are examined. Characteristics of the emission spectra of crystals irradiated at 2730°K or above and at 80°K are described. The effects of annealing are also described. The presence of M and F_3^+ centers show that defects in the crystal irradiated at 273°K are point-like. The vacancies in the crystal irradiated at 80°K appear to be clustered. (JRD)

27394 HELIUM RELEASE FROM NEUTRON IRRADIATED BORON CRYSTALS. Born, E. (Technische Univ., Munich). Radiochim. Acta; 19: No. 1, 41-42(1973).

Discussions are presented on calculations, measurements, results, the helium released, and conditions of irradiation of boron by neutrons. (GE)

27395 EFFECT OF X RAY AND γ RADIATION OF ^{60}Co ON SOME THERMAL PROPERTIES OF SOLID SOLUTION KCl–KBr. Ivankina, M. S.; Vyatkina, A. V.; Sergunova, F. A. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 104-107(1973). (In Russian).

The effect of isodose x radiation and ^{60}Co γ quanta on the temperature coefficient of linear expansion α and the relative coefficient of thermal conductivity μ of solid solutions of the KCl–KBr system was studied as a function of its composition. The effect of the radiation dose on α and μ of solid solutions of different composition was also studied. (tr-auth)

27396 EFFECT OF γ RADIATION AND ELECTROSTATIC FIELD ON THE THERMAL EXPANSION OF TRIGLYCINE SELENATE AND DICALCIUMSTRONTIUMPROPIONATE CRYSTALS DURING PHASE TRANSFORMATION. Varikash, V. M.; Zarembovskaya, T. A. (Minsk Radiotechnical Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 141-143(1973). (In Russian).

The linear expansion of triglycine selenate crystals along the [100], [010], and [001] planes and of dicalciumstrontiumpropionate crystals along the [100] and [001] planes was determined before and after irradiation. In the triglycine selenate irradiation flattens out the maximum in the thermal expansion curves in the phase transformation region. In the propionate crystals the coefficient of thermal expansion of the [001] direction has a sharp maximum in the phase transformation region after irradiation, but irradiation has no significant effect on the [100] direction. The imposition of an electrostatic field on the triglycine selenate leads to an increase of the values of the thermal expansion coefficient in the ferroelectric phase and a particularly large change occurs in the region of phase transformation. (3 graphs) (JSR)

27397 ROOM TEMPERATURE FATIGUE CRACK PROPAGATION IN REACTOR GRAPHITES. Marshall, P.; Priddle, E. K. (Central Electricity Generating Board, Berkeley, Eng.). Carbon; 11: No. 5, 541-546(Oct 1973).

Fatigue crack propagation studies on two reactor graphites have established a crack propagation law which is compared with fatigue models at room temperature. Predictions using this law for push-pull fatigue endurance correlate well with published experimental work. (auth)

27398 IRRADIATION DAMAGE TO PYROLYTIC GRAPHITES AT VERY HIGH TEMPERATURES. Burleigh, D. D.; Thrower, P. A. (Pennsylvania State Univ., University Park). Carbon; 11: No. 5, 505-510(Oct 1973).

Six pyrolytic graphites of widely differing crystallite sizes (La = 1 to 120 μm) were irradiated at temperatures of 1020 and 1475°C. The resulting damage was studied by transmission electron microscopy. Damage produced at 1020°C can be understood in terms of present nucleation ideas, assuming crystallite boundaries interfere with homogeneous nucleation when La is smaller than the separation of homogeneously nucleated defects. At the higher temperature there is an increase in defect density rather than a decrease as observed over the temperature range 150 to 1200°C. It is proposed that this is caused by the nucleating cluster being larger than in the lower temperature range, and hence having a larger migration activation energy, approximately 2 eV as opposed to 1.2 eV. (auth)

27399 IRRADIATION EFFECTS BY ^{60}Co ON THE CARBON RESISTOR. Chee, C. K.; Cho, S. W. J. Koresn Inst. Elec. Eng.; 22: No. 4, 7-10(1973).

The characteristics of all the instruments and materials used in atomic industry are changed due to damages by the effects of radiation. Radiation effects on the carbon resistor, the main element of electrical circuits, have been investigated. It was found that the resistance value in carbon resistors is exponentially increased as the quantity of irradiation by gamma-ray is increased, but in case of more than 10^6 R/hr of irradiation it has saturated-state value. The rate of change in resistance value has been independent of the intensity of gamma rays when carbon resistors are irradiated to the same exposure. The resistance value in irradiated carbon resistors does not vary with elapse of time. The greater the distance from the carbon resistors to the gamma-ray source the more the resistance value is decreased and it has been shown that the greater the quantity of irradiation by gamma-ray, the greater the rate of decrease in resistance value. It is concluded that the measurement values obtained by the high-precision instruments in the radiation field have to be corrected with proper consideration to radiation damages. (Korean Sci. Abstr.)

27400 RADIATION DAMAGE AND DECAY CHARACTERISTICS OF ZINC SELENIDE EMISSION BANDS AND THEIR EQUIVALENCE TO ZINC SULFIDE EMISSION BANDS. Bryant, F. J.; Manning, P. S. (Hull Univ., Eng.). J. Phys. Chem. Solids; 35: No. 1, 97-101(Jan 1974).

Irradiation of zinc selenide at ~20°K with electrons capable of displacing zinc atoms results in the production of cathodoluminescence emission bands at 610 and 630 nm. Enhancement of the 630 nm emission band by electron damage requires the presence of copper in the samples. These emissions have been shown to give a peak energy shift to lower energies after excitation, as is characteristic of donor-acceptor pair recombination. It is concluded that the 610 and 630 nm emission bands of zinc selenide are equivalent to the self-activated and copper green emission bands of zinc sulfide. The 530 nm emission band of zinc selenide is not sensitive to electron damage, shows no time shift and is thought to be equivalent to the copper blue emission of zinc sulfide. (auth)

27401 MULTIPLE SCATTERING OF CHANNELING IONS IN CRYSTALS. II. Planar Channeling. Beloshitski, V. V.; Kumakhov, M. A.; Muralev, V. A. (Moscow State Univ.). Radiat. Eff.; 20: No. 1-2, 95-109(1973).

Planar channeling is discussed. The Fokker-Planck kinetic equation is derived for charged particle scattering in planar channeling. The main factors that affect dechanneling are examined. Comparison of the obtained solutions with experimental data on dechanneling shows satisfactory agreement. The importance of nuclear scattering due to discreteness of the atomic plane is demonstrated. The depth-dependence of the flux peaking effect is investigated. Also, the dependence of a channeled ion profile on direction, energy, and temperature is studied. It is inferred that the approximation of monotonic gain of the transverse energy (that is commonly used in the interpretation of experiments and that does not include the diffusion in the transverse energy space) proves to be unsatisfactory. (auth)

27402 RADIATION EFFECTS ON MECHANICAL PROPERTIES OF CARBON/CARBON COMPOSITES. Bullock, R. E.; McKague, E. L. (General Dynamics, Fort Worth, TX). Carbon; 11: No. 5, 547-553(Oct 1973).

Two types of carbon/carbon composites were irradiated to a fast neutron fluence of 2×10^{18} n/cm^2(E > 1 MeV) in a helium atmosphere at 175°C. These specimens were mechanically tested in flexure and in shear to determine resulting property changes. Shear strengths at room temperature were increased by 25% or more by irradiation, and these increases in shear strengths allowed the composites to be flexed to higher stress levels (15 to 25%) before undergoing permanent deformations. These property improvements were retained by the materials up to temperatures of at least 1000°C in an inert environment. (auth)

27403 ATOMIC DISPLACEMENT EFFECTS ON THE CATHODOLUMINESCENCE OF ZnSe IMPLANTED WITH Yb IONS. Bryant, F. J.; Goodwin, G. K.; Hagston, W. E. (Univ. of Hull, Eng.). Proc. Phys. Soc. (London); 337: No. 1608, 21-47(5 Mar 1974).

The cathodoluminescence emission spectrum of Yb^{3+} in zinc selenide was observed following ion implantation. The complexity of the resulting spectrum was interpreted in terms of several distinct trigonally distorted lattice sites. The crystal field parameters obtained in this way indicate an appreciable degree of covalency between the rare-earth ions and the lattice. It was found that all Yb^{3+} spectra in zinc selenide are damage-sensitive and the resulting effects can be interpreted on the assumption that the excitation mechanism is indirect, resonance transfer between like rare-earth ions is occurring, and the concentration of centers is being changed. In turn, these concentration changes are used to determine a threshold energy of 8.0 eV (≡ 199 keV for the incident electron energy) for zinc displacement and an activation energy for thermal annealing of 0.14 ± 0.01 eV, tentatively assigned to zinc interstitial motion. (auth)

27404 EPR AND ENDOR OF TITANIUM-DOPED LITHIUM FLUORIDE. Davies, J. J. (Univ. of Hull, Eng.). J. Phys., C (London); 7: No. 3, 599-609(7 Feb 1974).

X or γ-irradiation of Ti-doped LiF produces an EPR center of axial symmetry about a ⟨111⟩ axis with $S = \frac{1}{2}$, $g_{||} = 1.971 \pm 0.001$ and $g_{\perp} = 1.815 \pm 0.001$. The spectrum is attributed to Ti^{3+}. ENDOR of the surrounding ^{7}Li and ^{19}F nuclei shows the titanium to be displaced by between 0.02 and 0.03 nm in a ⟨111⟩ direction from a lithium site, and suggests that three of the nearest fluorine neighbors are replaced by charge-compensating O^{2-} ions. The centers are no longer observed after the crystals have been heated to 300°C and have yielded the thermoluminescence glow peaks used for radiation dosimetry. (auth)

27405 ELECTRON BOMBARDMENT CONDUCTIVITY OF CdS. Gibbons, D. J. (EMI Ltd., Hayes, Eng.). J. Phys., D (London); 7: No. 3, 429-432(11 Feb 1974).

Measurements were made of electron bombardment conductivity (EBC) of intentionally doped CdS single crystals and evaporated films. An EBC gain as high as 10^{11} was observed on one specimen. The influence of contacts was studied. (auth)

27406 TRAPPED SPACE CHARGES IN ELECTRON-BOMBARDED INSULATORS. Gibbons, D. J. (EMI Ltd., Hayes, Eng.). J. Phys., D (London); 7: No. 3, 435-442(11 Feb 1974).

Experimental studies were made on electron-bombarded thin insulating films of ZnS, As_2S_3, and doped CdS. Under an applied electric bias field, one of the results of bombardment in the case of the first two is in the buildup of an internal static space charge due to trapped carriers. The speed with which this charge is established and released by electron beam excitation was studied. In the case of CdS, it is found that the dominant result of bombardment is not carrier trapping, but the results lend further support to the suggestion that electron bombardment conductivity (EBC) in doped CdS is influenced very strongly by the release of carriers already trapped. The simplified model used for volume charge storage leads to other results substantially in agreement with EBC phenomena in ZnS and As_2S_3. (auth)

27407 ABSORPTION OF X-COLOURED RbCl:Sr IN THE F REGION. Katz, I.; Kristianpoller, N.; Englman, R. (Univ. of Tel Aviv, Israel). Phil. Mag.; 29: No. 2, 373-382(Feb 1974).

Absorption spectra of X-rayed RbCl:Sr were investigated in the visible region and compared to that of pure RbCl. The half-width of the F band in Sr-doped RbCl was 0.24 eV (at 77°K) compared to 0.19 eV in pure RbCl. The shape of the F band in the doped crystal did not fit a single Gaussian. Thermal annealing to about 420°K reduced the halfwidth to 0.19 eV and caused the shape of the F band in RbCl:Sr to coincide with the Gaussian shape of the F band in the pure crystal. An absorption band at 2.85 eV was found to grow and decay proportionally with the Z_1 band (1.78 eV). A theoretical approach is outlined which takes into account the strong admixture of the 1s and $2p_z$ states of the F center due to the lowering of the symmetry in the Z_1 center. (auth)

27408 ISOTHERMAL ANNEALING OF ARSENIC-IMPLANTED SILICON. Cappellani, F.; Restelli, G.; Spinoni, L. (Commission of the European Communities, Ispra, Italy). J. Phys., C (London); 7: No. 3, L50-L53(7 Feb 1974).

Isothermal annealing studies of arsenic-implanted silicon were made at temperatures above 550°C for a dose below the amorphization limit. The process appears to follow first-order reaction kinetics with an activation energy of about 1 eV in the temperature range 550 to 850°C. (auth)

27409 EFFECT OF IONIZING RADIATIONS ON THE CRYSTALLINE STRUCTURE AND ELECTRIC RESISTIVITY OF CdS THIN FILMS. Baltateanu, N.; Spinulescu, I. (Institutul de Fizica Atomica, Bucharest). Radiat. Eff.; 20: No. 3, 149-152 (Nov 1973).

Cadmium sulfide films, 0.5 to 2.0 μm in thickness, were prepared by thermal evaporation in vacuum. The substrate was optically flat silica glass. The substrate temperature ranged between 50 and 550°C and the evaporation temperature was varied between 650 and 1100°C. Films obtained in various experimental conditions were irradiated with 3-MeV electrons and bremsstrahlung from an electron linac, to doses of 5×10^{7} to 2×10^{10} and 10^{6} to 5×10^{7} rad respectively. The crystalline structure was studied before and after irradiation by electron diffraction from the surface of the film without removing it from the substate. The electric resistance of the samples was measured at room temperature. The results are presented and discussed. (UK)

27410 EPITAXIAL GROWTH OF CdTe FROM THE ELEMENTS IN A CURRENT OF HYDROGEN. Vanyukov, A. V.; Krotov, I. L.; Mikolyuk, E. A. (Moscow Inst. of Steel and Alloys). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 9, 1334-1338(Sep 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 9, 1497-1502(Sep 1973).

Monocrystalline CdTe films on various different substrates were obtained by synthesis from the elements in a current of hydrogen. The ratio of the partial vapor pressures of Cd and Te has a marked effect on the rate of film growth without affecting the character of the temperature distribution of ΔZ. The value of p_{Cd}/p_{Te} varies markedly with decreasing deposition temperature, according to the initial value. Supersaturation and its variation along the crystallization zone are determined by the rate of cooling of the gas mixture. Supersaturation and the substrate temperature determine the physicochemical conditions of epitaxial growth, and the composition of the vapor phase above the substrate determines the properties of the film. (auth)

27411 ELECTRICAL RESISTANCE OF CARBON MATERIALS AND ITS ALTERATION BY IRRADIATION. Virgil'ev, Yu. S.; Makarenko, V. G. Inorg. Mater. (USSR) (Engl. Transl.); 9, 1375-1378(Sep 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 9, 1546-1550(Sep 1973).

In carbon materials the electrical resistivity depends exponentially on the porosity. The resistivity is proportional to the diameter of the regions of coherent scattering (RCS) for graphitized materials and is practically independent of it for nongraphitized materials. After irradiation, the resistivity becomes practically independent of the RCS diameter. (auth)

27412 PERTURBED $[F_2^-]$ CENTRES IN $KZnF_3$. Kappers, L. A.; Halliburton, L. E. (Oklahoma State Univ., Stillwater). J. Phys., C (London); 7: No. 3, 589-598(7 Feb 1974).

Optical and ESR experiments on gamma-irradiated $KZnF_3$ crystals show that three types of perturbed $[F_2^-]$ centers are produced at 77°K. These defects basically consist of a trapped hole equally shared by two neighboring fluorine ions, and are similar to the $[X_2^-]$ centers in the alkali metal halides. The thermally induced decay of the three centers occurs at 150, 225, and 310°K. The corresponding optical absorption for each of the centers is at 3.27, 3.33, and near 3.45 eV. Anisotropic absorption induced in the crystals by preferential alignment is observed in the optical spectra of the centers decaying at 225 and 310°K. These two centers are believed to be stabilized by impurity ions. The center decaying at 150°K exhibits rapid motional behavior in the form of a pronounced ESR line broadening in the temperature range above 92°K. The failure to observe preferential alignment at 77°K in the optical absorption spectrum of this defect also suggests rapid motional behavior. A plausible model compatible with these results is that of the fluorine molecular ion located adjacent to a cation vacancy. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

27413 (AD-768754-4-GA) RADIOACTIVE MATERIAL ACCOUNTABILITY: A COMPUTER ROUTINE TO PRODUCE THE REQUIRED RECORDS. Marquiss, R. P. (Naval Ordnance Lab., White Oak, Md. (USA)). 8 Aug 1973. 35p. (NOLTR-73-146). NTIS $3.00.

The maintenance of accurate radioactive material accountability records is one of the perpetual problems associated with the pursuit of an effective health physics program. A small but vitally important section of the accountability requirement is the periodic leak testing of all sealed quantities of radioactive materials. Leak test records must be maintained to show that the tests were performed, and that leakage, if any, is within the allowable limits. There are many methods that can be used to satisfy the record keeping requirements. The choice of method is somewhat dictated by the size of the inventory and the available computational equipment. Where a modern multi-language digital computer is available, the computerization of the inventory maintenance problem will provide for accurate records at low cost. One such scheme of computer record keeping is presented. Portions of this document are not fully legible. (GRA)

27414 (K-1839(Pt. 3)) BEHAVIOR OF THE MINOR URANIUM ISOTOPES IN SEPARATION CASCADES. Part III. A Long Cascade Designed for the Production of a Small Quantity of Highly Enriched Uranium Simultaneously With a Much Larger Quantity of Power Reactor Fuel. Blumkin, S.; Von Halle, E. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 22 Mar 1974. Contract W-7405-eng-26. 47p. Dep. NTIS $4.00.

This is the third part of a study directed at assessing the usefulness of determinations of the concentrations of the minor uranium isotopes in cascade feed and withdrawal streams as a complementary safeguards technique for ^{235}U enrichment plants. A nearly ideal multisection (squared-off) gaseous diffusion cascade was designed for the simultaneous production of a small quantity of highly enriched uranium with a ^{235}U concentration of 90% and a much larger quantity of power reactor-grade uranium enriched to 4% ^{235}U. The behavior of the ^{234}U, ^{235}U, and ^{236}U in this cascade and the cascade performance have been examined for a variety of operating conditions involving reactor tails uranium in addition to natural uranium as cascade feed. It is shown that the concentration of both ^{234}U and ^{236}U relative to that of ^{235}U in the cascade withdrawal streams is affected significantly by changes in operating conditions even when conditions are chosen such that the ^{235}U concentration of these streams is maintained constant. This suggests that the measurements of the ^{234}U and ^{236}U concentrations in addition to that of ^{235}U in the feed and withdrawal streams of an enrichment cascade could have some potential as a safeguards technique. (auth)

27415 (LA-5557-PR) NUCLEAR ANALYSIS RESEARCH AND DEVELOPMENT. Program Status Report, September–December 1973. Keepin, G. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 23p. Dep. NTIS $4.00.

The status of the Nondestructive Assay R & D program of the LASL Nuclear Analysis Research Group, A-1 for the reporting period is presented. Topics discussed include: delayed-neutron assay of small samples using subthreshold neutron interrogation; random driver measurements at the LASL uranium recovery facility; assay of NVOO Rover fuel inventory at NRDS; spectrum of delayed neutrons from fast fission of ^{235}U; passive gamma-ray assay services; neutron multiplication and leakage characteristics for UF_6 cylinders; solid transuranic waste assay at the 10-nCi/g level; portable uranium water effluent monitor; multienergy californium assay system (MECAS); photoneutron (Sb–Be) assay system for small samples; computer based gamma-ray assay system upgrading; PDP-9/L computer-based data acquisition system; measurement of the time resolution of several ^4He and CH_4 proportional counters; measurement uncertainty due to calibration of NDA instruments; and the USAEC nondestructive assay training program. (TFD)

27416 (RCN-202) SAMPLE SIZES FOR STATISTICAL ESTIMATION AND DISCREPANCY DETECTION. Zijp, W. L. (Stichting Reactor Centrum Nederland, Petten). 9 Jan 1974. 79p. (CONF-740308-3). Dep. NTIS (U. S. Sales Only) $6.00.

From European safeguards research and development symposium; Rome, Italy (7 Mar 1974).

After an introduction on some aspects of sampling, the report presents criteria for determining the required sample size as follows: (1) estimation when the confidence level α is given, and (2) detection of discrepancies when the confidence level and the discriminatory power of the statistical test are given. The applications to safeguards are indicated. (auth)

27417 (RCN-204) GUIDELINES FOR THE TREATMENT OF ERRORS IN NUCLEAR MATERIAL ACCOUNTANCY AND SAFEGUARDS. Zijp, W. L. (Stichting Reactor Centrum Nederland, Petten). 9 Jan 1974. 130p. (CONF-740308-4). Dep. NTIS (U. S. Sales Only) $8.50.

From European safeguards research and development symposium; Rome, Italy (7 Mar 1974).

Discussions on the effect of the simultaneous occurrence of systematic and random errors on the uncertainty of the overall measurement result are very rare in the literature. Because of the important role of such errors in the field of nuclear material accountancy and safeguards, the ESARDA working group on systems analysis gave full attention to this problem. After a summary of important concepts and formulas, a series of practical applications and examples, which are of interest for operators of nuclear facilities are presented. It is hoped that operators will provide the working group with plant data which will enable the methods described in the report to be more fully tested. (auth)

27418 CONTROL CHARGS FOR MUF's. JAECH, J. L. Nucl. Mater. Manage.; 2: No. 4, 16-28(Win 1974).

The control chart presented in TID-26298-"Statistical Methods in Nuclear Materials Control" is discussed with the primary emphasis being an investigation of the conditions under which the special control chart represents an advantage over the somewhat simpler standard control chart. (TFD)

27419 RAPID ASSESSMENT OF ^{235}U IN USED HIGH-EFFICIENCY PARTICULATE AIR FILTERS. Heine, W. F.; Moore, J. D. Nucl. Mater. Manage.; 2: No. 4, 13-15(Win 1974).

Current special nuclear material safeguards requirements preclude the disposal of high-efficiency particulate air (HEPA) filters which have been used in air exhaust systems for areas in which enriched uranium is utilized until the amount of ^{235}U contained in the filter has been determined. To this end, a technique has been developed for evaluating ^{235}U contained in used HEPA filters by selectively measuring the emission rate of the 0.185 MeV (54%) photon from ^{235}U. Counting of the 0.185 MeV photon is performed with a NaI(Tl) planar gamma detector, driving a portable, battery-operated pulse rate meter with single-channel pulse height analyzer and pulse integrator capabilities. Filters are placed in a fixture designed to assure consistent source-detector geometry, and subjected to an appropriate count on each face of the filter medium with the detector positioned at the center of the face at a distance of 2" from the surface of the medium. The ^{235}U contained in the filter is determined on the basis of the observed count rate on a filter face and the ratio of the count rates on the two faces. (auth)

Disposal and Storage

Refer also to abstracts 26842 and 26844.

27420 (HWS-8828) SPECIFICATION FOR PROCUREMENT OF 55-GALLON DRUMS FOR STORAGE OF RADIOACTIVE MATERIALS. Ingalls, W. P. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 23 Aug 1972. 4p. Dep. NTIS $3.00.

Specifications for Class A and B 55-gal drums used for storing solid radioactive wastes are given. (TFD)

27421 (KFK-1820) DISPOSAL OF RADIOACTIVE WASTES INTO THE UNDERGROUND IN THE FEDERAL REPUBLIC OF GERMANY: A SURVEY ON PRACTICAL EXPERIENCE AND R + D WORK. Hild, W. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Apr 1973. 28p. (CONF-730474-1). Dep. NTIS (U. S. Sales Only) $3.50.

From meeting of the disposal in the subsoil of industrial effluents; Rome, Italy (12 Apr 1973).

In the Federal Republic of Germany solid and solidified radioactive wastes are disposed of in the Asse salt mine. A short review is given of the extensive R and D programs already executed and still under way; practical experience gained during routine disposal operations is described. A survey is given of the program on deep-well injection of tritium-containing effluents into isolated depleted oil horizons of the deep underground that is being studied at Karlsruhe as an approach to tritium disposal which does not lead to the contamination of the biosphere. (GE)

27422 (LA-5512-PR) TRANSURANIC SOLID WASTE MANAGEMENT RESEARCH PROGRAMS. Quarterly Report, July–September 1973. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 24p. Dep. NTIS $4.00.

Progress during the reporting period of July–September 1973 on three transuranic solid waste management research programs funded by the AEC Division of Waste Management and Transportation is given. The three programs include transuranic solid waste management research and development, the contaminated waste treatment development facility, and the burial grounds evaluation. The interim storage criteria are now ready to be issued for general review. Experiments in radiolysis and container corrosion have been reorganized and expanded to provide information for optimization of interim storage, while waste sorting experiments have begun to determine more accurately the character of wastes being produced at LASL. Several task forces have been organized for the waste treatment facility to evaluate incinerators and determine a satisfactory operational size for the facility. Work has begun on developing a model for the risk analysis of radioactive burial grounds. A questionnaire has been developed to obtain the necessary information for the analysis. (auth)

27423 (LA-UR-74-530) IMPACT OF AECM 0511 ON OPERATIONS OF THE LOS ALAMOS SCIENTIFIC LABORATORY (LASL) LIQUID WASTE MANAGEMENT GROUP. Emelity, L. A.; Christenson, C. W. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 26p. (CONF-740406-2). Dep. NTIS $4.50.

From second AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

The liquid waste management group at LASL operates a number of facilities for treatment of radioactive liquid wastes. In one case, radioactive dewatered sludge must be packaged for disposal; in another a cement paste is the disposal problem. The sludge is normally below the retrievability levels of AEC Manual Chapter 0511, but it occasionally exceeds these levels. A system has been devised to assure that packaging is in accordance with the requirements of AECM 0511; the system and the materials used are described. The cement paste is usually in the "retrievable" category. However, some constituent wastes are not and can be separated. The retrievable paste portion will be packaged in corrugated metal pipe and stored in a designated area; the remainder will be placed into pits as at present. (auth)

27424 (NP-19966) RADIOACTIVE WASTE MANAGEMENT PRACTICES IN JAPAN. Nagai, Y. (Organization for Economic Co-Operation and Development, 75, Paris (France)). 1974. 43p. Dep. NTIS (U.S. Sales Only) $5.25.

Current procedures and the future scope of radioactive waste management practices in Japan are discussed. Information is included on: existing and planned nuclear power plants; nuclear power plant siting; history of radioactive waste management in Japan; estimated annual production of radioactive waste in Japan; basic concepts of radioactive waste management; preservation of the environment; waste management systems currently used for radioactive wastes produced by research institutes, industrial users of radioisotopes, nuclear power plants, and fuel cycle facilities; and future problems related to high-level and α-bearing radioactive wastes, ^{85}Kr and tritium management, the feasibility of undersea disposal, and public acceptance of nuclear facilities. (LCL)

27425 (ORNL-4935, pp 12-18) WASTE MANAGEMENT STUDIES. Tamura, T.; Brinkley, F. S.; Cathcart, T. Mar 1974.

In Environmental Sciences Division annual progress report for period ending September 30, 1973.

Field reconnaissance of the ORNL burial grounds has been completed, and installation of groundwater wells for systematic evaluation of suspected leaching areas is in progress. Mathematical models have been written to follow the movement of water and radionuclides in terrestrial environments. Laboratory studies are being conducted on biologic denitrification of high-nitrate wastes emanating from nuclear installations. Rate constants have been obtained for columnar denitrification, and factors affecting column life are being investigated. Special cements for sealing boreholes have been investigated. Cement properties, including strength, permeability, expansion, sulfate resistance, and bonding qualities, have been determined; these studies are in support of the Bedded Salt Pilot Plant Project for the disposal of radioactive wastes. A field-scale demonstration of borehole plugging is under way. (auth)

27426 (RFP-2143) STORAGE OF PLUTONIUM METAL IN SEALED CANS. Musgrave, L. E. (Dow Chemical U. S. A.; Golden, Colo. Rocky Flats Div.). 15 Mar 1974. Contract AT(29-1)-1106. 12p. Dep. NTIS $4.00.

Experiments have been conducted to assess the corrosion and fire hazards of plutonium metal stored in sealed produce cans. The amount of corrosion observed was about 10 times less than that expected in freely flowing air of 20 to 30% relative humidity. The reduction in corrosion is due to the reduced amount of oxidizer present in the sealed can; however, oxygen in air is not the chief oxidizer. Experiments with cans sealed in air and those sealed in low-oxygen atmospheres showed little difference in the amount of corrosion that later occurred. This suggests the main oxidizer is water vapor adsorbed inside the can. Experiments showed, however, that up to 40 g of molecular sieve was not effective in reducing the corrosion. Ignition experiments with corrosion products from unalloyed plutonium buttons showed the material to be combustible. In fact, when piled to sufficient depth on the button (about $\frac{1}{8}$ in.), the corrosion product can burn when ignited by scratching the button. (auth)

27427 SOLID WASTE TREATMENT AND DISPOSAL. International Edition of the 1971 Australian Waste Disposal Conference, Sydney, Australia, February 17–19, 1971. Kirov, N. Y. (ed.). Ann Arbor, MI; Ann Arbor Science Publishers Inc. (1972). 211p. (CONF-710231-). $14.50.

The conference was broad in scope, covering sampling, characterization, transport and disposal of wastes by landfill, dumping, incineration and composting. Special problems covered include disposal of radioactive wastes, wood wastes, wastes from coal mining operations, and the effects of waste disposal on air and water pollution. Aspects on salvaging and reuse of various wastes are also considered. (TFD)

Handling Equipment and Procedures

27428 VIRGULE INTERVENTION VEHICLE: A NEW GENERATION OF REMOTE CONTROLLED EQUIPMENT. Vertut, J. (CEN de Saclay, Gif-sur-Yvette, France). Radioprotection; 8: No. 2, 139-162(1973). (In French).

VIRGULE is a remote controlled vehicle provided with a pair of manipulators and television cameras. The MA22 type electronic servocontrolled master-slave manipulators can exert a force of 120 Newtons in any direction and lift 40 kg from certain positions. The supporting vehicle possesses 4 flexibly positioned wheels and an extending front axle which when in the extended position allows the vehicle to be driven over very rough ground, and when in the retracted position allows the vehicle to pass through a normal door (0.80 m). The vehicle can move along straight lines in any direction with respect to its own axis; in addition it can pivot about any center of rotation and not only about its back axle as with conventional vehicles. The command of the VIRGULE equipment necessitates the transmission of analogue signals together with yes/no signals for the control of various circuits. This information is transmitted from the control point to the vehicle after being digitally coded by a system having 24 channels, 16 of which are permanently used either by two manipulators, or by one manipulator and the vehicle. In addition, there are 16 analogue channels for the vehicle-control point sense information and the television image functioning. The transmission is ensured by two coaxial cables or a radio link. The VIRGULE vehicle (500 kg) can climb stairs and operate autonomously with the aid of its batteries for about 4 h. (FR)

27429 CRITICALITY: PREVENTION, ACCIDENTS AND INCIDENTS, ALARMS, AND DOSIMETRY. Gey, A. (CEN de Saclay, Gif-sur-Yvette, France). Radioprotection; 8: No. 2, 97-117(1973). (In French).

A definition is given of the critical state (state of a multiplying medium in which the instantaneous equation for the appearance and disappearance of particles is zero). The factors associated with the criticality are discussed together with the different methods of controlling the criticality. A criticality accident (Wood River Junction, 1954) and an incident (CEA 1965) are described. Various criticality alarm systems are presented. (FR)

27430 IRRADIATED-FUEL TESTING FACILITY AND ITS ONE-YEAR OPERATION. Kobayashi, S. (Power Reactor and Nuclear Fuel Development Corp., Ibaraki, Japan). Doryokuro Giho; No. 6, 65-74(Dec 1972). (In Japanese).

The facility in the Oarai Engineering Center of PNC, completed a year ago, is for the development of fast-reactor fuel and materials in Japan. It is used to study the irradiation behavior of Pu fuel and to carry out metallurgical, physical, and chemical tests. It consists of a 10,000-Ci cell line, a 2,000-Ci cell line, and an adjoining loading station and microscopic observation cells. Post-irradiation tests of the fuels irradiated in reactors in overseas countries and also in JMTR of JAERI have been performed in the past year. These include tests on fuel cladding tubes soaked in sodium, fuel pins, fuels and fuel assemblies for Joyo, i.e., an experimental fast reactor, regarding safety, integrity, etc. at various burnups. (JA)

Transportation

27431 (PB-197566) CONFERENCE ON TRANSPORTATION OF RADIOACTIVE MATERIAL HELD IN CHARLOTTESVILLE, VIRGINIA ON 26-27 OCTOBER 1970. (Virginia Univ., Charlottesville (USA)). 16 Nov 1970. 216p. (CONF-701079-). NTIS.

A separate abstract was prepared for twelve of the thirteen papers presented at the conference. The remaining paper was previously abstracted in NSA as 25: 48884. (TFD)

For abstracts of individual papers see: 27432-27443.

27432 (PB-197566, pp 14-54) REVIEW OF THE DEPARTMENT OF TRANSPORTATION (DOT) REGULATIONS FOR TRANSPORTATION OF RADIOACTIVE MATERIALS. Grella, A. W. (Dept. of Transportation, Washington, DC). 16 Nov 1970.

From conference on transportation of radioactive material; Charlottesville, Virginia, USA (26 Oct 1970).

In conference on transportation of radioactive material held in Charlottesville, Virginia on 26-27 October 1970.

A summary of the basic requirements of the Department of Transportation (DOT) regulations governing the packaging and shipment of radioactive materials is presented. (TFD)

27433 (PB-197566, pp 55-64) AEC REGULATIONS FOR THE PACKAGING OF RADIOACTIVE MATERIALS FOR TRANSPORT. MacDonald, C. E. (Div. of Materials Licensing, Washington, DC). 16 Nov 1970.

From conference on transportation of radioactive material; Charlottesville, Virginia, USA (26 Oct 1970).

In conference on transportation of radioactive material held in Charlottesville, Virginia on 26-27 October 1970.

The basic concepts and principal provisions of AEC regulations for the packaging of radioactive materials for transport are discussed. (TFD)

27434 (PB-197566, pp 65-76) CONTAINERS FOR SHIPMENT OF RADIOACTIVE MATERIAL. Seagren, R. D. (Oak Ridge National Lab., TN). 16 Nov 1970.

From conference on transportation of radioactive material; Charlottesville, Virginia, USA (26 Oct 1970).

In conference on transportation of radioactive material held in Charlottesville, Virginia on 26-27 October 1970.

The use of Type A and B packages for the shipment of radioactive materials is briefly discussed. (TFD)

27435 (PB-197566, pp 77-96) RESPONSIBILITIES OF THE CONSIGNOR AND THE CONSIGNEE. Schendel, K. R. (Westinghouse Electric Corp., Pittsburgh). 16 Nov 1970.

From conference on transportation of radioactive material; Charlottesville, Virginia, USA (26 Oct 1970).

In conference on transportation of radioactive material held in Charlottesville, Virginia on 26-27 October 1970.

The legal, practical, and social responsibilities of shippers and receivers of radioactive materials are reviewed. (TFD)

27436 (PB-197566, pp 97-100) CARRIERS RESPONSIBILITY IN TRANSPORTING HAZARDOUS MATERIALS. Black, W. (Federal Railroad Administration, Washington, DC). 16 Nov 1970.

From conference on transportation of radioactive material; Charlottesville, Virginia, USA (26 Oct 1970).

In conference on transportation of radioactive material held in Charlottesville, Virginia on 26-27 October 1970.

The responsibility of carriers of radioactive materials from the time of receipt to time of delivery is reviewed. (TFD)

27437 (PB-197566, pp 101-118) NUCLEAR FUEL SHIPMENTS: NOW AND PROJECTED. Walchli, H. E. (Westinghouse Electric Corp., Pittsburgh). 16 Nov 1970.

From conference on transportation of radioactive material; Charlottesville, Virginia, USA (26 Oct 1970).

In conference on transportation of radioactive material held in Charlottesville, Virginia on 26-27 October 1970.

The shipping requirements for uranium from the time it is removed from the ground as ore to the time it is in the form of spent fuel elements are briefly reviewed. (TFD)

27438 (PB-197566, pp 119-128) TRANSPORTATION OF SPENT NUCLEAR FUEL. Peyton, A. T. Jr. (Southern Interstate Nuclear Board, Atlanta). 16 Nov 1970.

From conference on transportation of radioactive material; Charlottesville, Virginia, USA (26 Oct 1970).

In conference on transportation of radioactive material held in Charlottesville, Virginia on 26-27 October 1970.

The problems of transporting spent fuel elements by highway vehicles due to weight limitations imposed by various states are described. (TFD)

27439 (PB-197566, pp 129-148) PHYSICAL PROTECTION OF RADIOACTIVE MATERIAL IN TRANSIT. Wischow, R. P. (Nuclear Audit and Testing Co., Washington, DC). 16 Nov 1970.

From conference on transportation of radioactive material; Charlottesville, Virginia, USA (26 Oct 1970).

In conference on transportation of radioactive material held in Charlottesville, Virginia on 26-27 October 1970.

Regulations pertaining to physical protection of fissile materials during transit are briefly discussed. Case histories of misrouted or misplaced shipments are given. Some corrective actions to prevent future occurrences are suggested. (TFD)

27440 (PB-197566, pp 149-189) INSURANCE ASPECTS OF THE TRANSPORTATION OF RADIOACTIVE MATERIAL. Weaver, G. L. (Marsh and McLennan, Inc., Atlanta). 16 Nov 1970.

From conference on transportation of radioactive material; Charlottesville, Virginia, USA (26 Oct 1970).

In conference on transportation of radioactive material held in Charlottesville, Virginia on 26-27 October 1970.

A detailed analysis of insurance activities pertaining to radioactive materials in transit is presented. (TFD)

27441 (PB-197566, pp 190-195) SPECIALIZED SHIPMENTS OF RADIOACTIVE MATERIAL. Brown, J. F. (National Lead Co., Wilmington, DE). 16 Nov 1970.

From conference on transportation of radioactive material; Charlottesville, Virginia, USA (26 Oct 1970).

In conference on transportation of radioactive material held in Charlottesville, Virginia on 26-27 October 1970.

The procedures to be followed for shipping of spent fuel elements from a research and test reactor to a reprocessing plant are presented. (TFD)

27442 (PB-197566, pp 196-208) WHAT GOOD IS THE AEC: IN A RADIATION EMERGENCY? Thornton, W. T. (USAEC Div. of Safety and Environmental Control, Oak Ridge, TN). 16 Nov 1970.

From conference on transportation of radioactive material; Charlottesville, Virginia, USA (26 Oct 1970).

In conference on transportation of radioactive material held in Charlottesville, Virginia on 26-27 October 1970.

The AEC Radiological Assistance Program is described and its application to transportation accidents involving radioactive materials is discussed. (TFD)

27443 (PB-197566, pp 209-217) SUPPLIER'S REVIEW OF THE TRANSPORTATION OF RADIOACTIVE MATERIALS. Killian, C. B. (New England Nuclear Corp., Boston). 16 Nov 1970.

From conference on transportation of radioactive material; Charlottesville, Virginia, USA (26 Oct 1970).

In conference on transportation of radioactive material held in Charlottesville, Virginia on 26-27 October 1970.

The experience of the New England Nuclear Corp. of Boston, Mass. in shipping radioactive materials is presented. Causes and prevention of shipping accidents are discussed. (TFD)

27444 (TID-26541) SYSTEM DESIGN DESCRIPTION FOR THE F-144-1 SHIPPING CONTAINER. (Battelle Columbus Labs., Ohio (USA)). 25 Sep 1972. 32p. Dep. NTIS $4.75.

For E. I. DuPont de Nemours and Co., Inc., Aiken, SC.

The F-144-1 Shipping Container is intended for the shipment of unirradiated FFTF or other LMFBR fuel pins and fuel pin assemblies by common carrier truck or tractor-trailer. The container provides protection and containment of the fuel pins and fuel pin assemblies for the normal handling and hypothetical accident conditions specified in the AEC Requirement of 10-CFR-Part 71 of the Code of Federal Regulations. In addition, the container provides cushioning of the fuel pins and fuel pin assemblies to a maximum shock force of 6 g (6 times the force of gravity) in the event of a free drop of the container from a height of 4 ft. Component and overall design, operation, safety, and maintenance of the shipping container are discussed in detail. An appendix on fabrication specifications, hydrostatic testing, and painting specifications is provided. (auth)

27445 MOBILE CARRIER FOR A RADIOACTIVE MATERIAL SHIPPING CONTAINER. Peterson, R. W.; Backus, H. A. (to NL Industries, Inc.). US Patent 3,797,860. 19 Mar 1974. Filed date 24 May 1971. 6p.

The mobile carrier includes a supporting framework having spaced support means connected to the framework for supporting opposite ends of the shipping container. The portions of the framework between said support means are placed in tension while the shipping container is placed in compression thereby substantially reducing the required weight and size of the supporting frame members. (6 claims, 6 drawing figures) (Official Gazette)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 27744.

27446 (JINR-P9-7697) COLLECTIVE HEAVY ION ACCELERATOR OF NEW ACCELERATION METHOD DEPARTMENT (JINR). Barabash, L. S.; Belyaev, L. N.; Golutvin, I. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 44p. (In Russian). Dep. NTIS (U.S. Sales Only) $5.25.

The present status of research on collective methods of acceleration is reviewed. Information on the collective heavy ion accelerator of the New Acceleration Method Department (JINR) is presented. (auth)

27447 (SLA-74-5100) THEORETICAL MODELS OF COLLECTIVE ION ACCELERATION. Olson, C. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 26p. (CONF-740316-2). Dep. NTIS $3.50.

From conference on electrostatic and electromagnetic confinement of plasmas and the phenomenology of relativistic electron beams; New York, New York, USA (4 Mar 1974).

Ion acceleration by drifting intense relativistic electron beams has been observed at several laboratories over the past six years. There is considerable interest in trying to understand the acceleration mechanism, its scaling laws, and its potential for use in future high energy ion accelerators. In this paper, acceleration mechanisms involving space charge fields, inductive fields, and collective wave fields are examined. Seven theoretical models are discussed, including the 1-D potential well models of Rostoker, Uglum, et al., Rosinskii, et al., and Poukey and Rostoker; the localized pinch model of Putman; the inverse coherent Cherenkov radiation model of Wachtel and Eastlund; and a recent 2-D potential well model of Olson. It is shown that only the last model is capable of explaining the existing data. Theoretical limitations of the acceleration process are discussed, and two new acceleration schemes (recently proposed by Olson) that overcome these limitations, are presented. (34 references) (auth)

27448 (SLA-74-5169) EXPERIMENTAL STUDIES OF COLLECTIVE ION ACCELERATION. Kuswa, G. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 37p. (CONF-740316-1). Dep. NTIS $4.00.

From conference on electrostatic and electromagnetic confinement of plasmas and the phenomenology of relativistic electron beams; New York, New York, USA (4 Mar 1974).

The history of linear collective acceleration experiments is briefly treated; several configurations in which collective ion acceleration has been observed at Sandia Laboratories are described; and experimental techniques used and results obtained to date are outlined. Short explanations of the acceleration process are included so that similarities in results of ions accelerated in diodes and in drift tubes can be appreciated. (WHK)

27449 AUTOACCELERATION OF AN INTENSE RELATIVISTIC ELECTRON BEAM. Friedman, M. (U. S. Naval Research Laboratory, Washington, D. C. 20375). Phys. Rev. Lett. 31: No. 18, 1107-1110 (29 Oct 1973).

A novel autoacceleration mechanism was used to double the particle energy in a pulsed relativistic electron beam. This mechanism increases electron kinetic energy at the expense of pulse duration. Acceleration is accomplished by passing the beam through a cavity structure inserted into a conventional drift tube. Experimental results showed that the mean electron kinetic energy was increased from about 0.5 to 1.0 MeV, while the beam duration decreased from about 50 to 25 nsec. The total energy efficiency of the process was approximately 75%. (auth)

Auxiliaries and Components

27450 (LAL-RI-73-6) STUDY AND DEVELOPMENT OF A MODULAR SYSTEM FOR AUTOMATICALLY POSITIONING THE BEAM OF THE ORSAY LINEAR ACCELERATOR. Borie, H. (Paris-11 Univ., 91-Orsay (France)). Jun 1973. 232p. Dep. NTIS (U. S. Sales Only) $14.75.

Thesis.

The elementary analog control loop beam position monitor responds within 2 or 3 pulses (i.e., in an average time of 40 to 60 ms with a repetition frequency of 50 Hz) to simultaneous or nonsimultaneous x and y displacements. These displacements are confined to an aperture (useful diameter of 18 mm) corresponding to the diameter of the cavity irises at the ends of the accelerating sections. No diaphony is observed between the horizontal and vertical channels. By the appropriate choice of sensor (TM_{120} cavity tuned to 3 GHz), an absolute definition is obtained for the centered beam, this not being the case for the majority of other types of differential measurement monitors. An optimal transmission of the beam can, as a result of misalignment, necessitate operating instructions other than $x = 0$, $y = 0$. A display is possible for all values throughout the range: $-5 \text{ mm} \leq x, y \leq +5$ mm. Fluctuations of less than 0.5 mm about the equilibrium position are achieved in spite of the secondary inputs from different perturbations. (FR)

Ion Sources and Injection and Extraction Systems

27451 (CONF-730470-1) P.I.G. SPUTTER SOURCE FOR NEGATIVE METAL IONS. Smith, H. V. Jr.; Richards, H. T. (Wisconsin Univ., Madison (USA). Dept. of Physics). [nd]. 7p. Dep. NTIS $3.00.

From meeting on the American physical society; Washington, District of Columbia, USA (23 Apr 1973).

Operating parameters for a cathode sputtering P. I. G. ion source with radial extraction for negative metal ion beam production for injection into the University of Wisconsin tandem accelerator are discussed. Beam emittance and beam intensity measurements are discussed. (WHK)

27452 (FRNC-TH-447) UTILIZATION OF AN EXTERNAL HEAVY ION SOURCE WITH THE ISOCHRONOUS GRENOBLE CYCLOTRON. Rallu, G. A. (Grenoble-1 Univ., 38 (France)). 1973. 139p. (In French). Dep. NTIS (U. S. Sales Only) $10.00.

Thesis.

The possibility of accelerating heavy ions in the isochronous cyclotron at Grenoble was studied. An internal Penning-type source was chosen for this purpose. The possibility of placing such a source outside the cyclotron was also examined. Two ways of extracting the ions from the magnetic field of the external source were studied. With the first method, the ions are guided in the median plane, and the curvature of the trajectories is inverted. With the second, an inflector is used to deflect the ions vertically through a hole in one pole of the source magnet. In addition a device for measuring emittances in a magnetic field was specially developed for these studies. In conclusion, both methods are suitable for the injection of heavy ions from an external source into the Grenoble cyclotron. (FR)

27453 (INIF-mf-1004) EXTRACTION OF PARTICLES FROM A COMPACT ISOCHRONOUS CYCLOTRON. Nieuwland, J. M. (Technische Hogeschool Eindhoven (Netherlands)). 7 Apr 1972. 92p. INIS.

The extraction of particles, accelerated in a compact isochronous cyclotron, has been studied. A technical description of the compact cyclotron and of the most important parts is given. The elements needed for the extraction (the electric deflection and the magnetic focusing of the deflected beam) are discussed. (INIS)

27454 CHARACTERISTICS OF ELECTROSTATIC CHARGED PARTICLE OSCILLATOR ION SOURCES. Swaminathan, S.; Venkatasubramanian, V. S. (Indian Inst. of Science, Bangalore). Pramana; 2: No. 1, 46-50(Jan 1974).

Two ion sources of the charged particle oscillator type are described. The discharge chamber consists of an outer cylinder as cathode and an axial wire or a pair of wires along the axis as the anode. The energy spectra and ionic composition of the ion beam have been measured with a double focusing mass spectrometer of the Mattauch–Herzog design constructed in the laboratory. A high percentage of dissociated ions and multiply charged ions has been observed in the ion beam. A brief description of the mass spectrometer is also given. (auth)

27455 DISTRIBUTION OF THE ELECTRIC FIELD AROUND A WIRE ARRAY ELECTROSTATIC SEPTUM. Durand, A. (Univ., Rennes, France). Compt. Rend., Ser. A, B; 277: No. 15, 407-410 (15 Oct 1973). (In French).

An expression is given for the electric field and the potential around a wire array electrostatic septum. The average electric field deviating the trajectories of the particle traversing the septum is deduced. (FR)

Ion Optics and Field Calculations

27456 (CERN-74-2) DECAY TURTLE (TRACE UNLIMITED RAYS THROUGH LUMPED ELEMENTS): A COMPUTER PROGRAM FOR SIMULATING CHARGED PARTICLE BEAM TRANSPORT SYSTEMS, INCLUDING DECAY CALCULATIONS. Brown, K. L.; Iselin, C. (European Organization for Nuclear Research, Geneva (Switzerland)). 5 Feb 1974. 59p. Dep. NTIS (U. S. Sales Only) $6.00.

TURTLE is a computer program designed to simulate charged particle beam transport systems. It allows evaluation of the effect of aberrations which exist in beams with small phase-space volume. These include higher-order chromatic aberrations, effects of non-linearities in magnetic fields, and higher-order geometric aberrations due to the accumulation of second-order effects. The beam at any point in the system may be represented by one- and two-dimensional histograms. The original version of TURTLE was created by D. C. Carey at NAL. The major part of this program and of the present manual are his work. In the CERN version of TURTLE, called DECAY TURTLE, provision has been made to include particle decay, following the parent particles and up to two kinds of daughter particles through the beam line. New additions to the code for this CERN version are indicated by italic script to distinguish from original TURTLE as written by D. C. Carey. (WHK)

27457 (INP-852) CALCULATION OF PARAMETERS OF THE UNIPOTENTIAL ELECTROSTATIC LENS. The Programme for Computer ODRA 1204. Lazarski, S.; Lipinska, E.; Rotocka, K. (Institute of Nuclear Physics, Krakow (Poland)). Sep 1973. 21p. (In Polish). Dep. NTIS (U. S. Sales Only) $4.25.

The PIXI and DIXI programs, composed for the ODRA 1204 computer, enable the parameters of the unipotential electrostatic lens for given main dimensions of the optical system to be calculated.

27458 (JINR-P9-7679) EXTENSION OF POSSIBILITIES OF THE ADGEZATOR MAGNETIC SYSTEM FOR A PRELIMINARY ION ACCELERATION. Zhabitskii, V. M.; Ivanov, I. N.; Lachinov, V. M.; Makoveev, V. K. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

A method is considered for extension of possibilities of the adgesator magnetic system for a preliminary ion acceleration. The method consists in changing the magnetic field gradient with the help of a conducting tube and in providing a definite correspondence between the radius of an electron ring and the tube radius. (auth)

Storage Rings

Refer also to abstract 27744.

27459 (DESY-73-57) PREPARATION FOR STORAGE RING EXPERIMENTS AT DESY. Waloschek, P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Nov 1973. 25p. (CONF-730988-2). Dep. NTIS (U. S. Sales Only) $3.25.

From international colloquium on photon-photon collisions in electron-positron storage rings; Paris, France (3 Sep 1973).

The present status of the construction of the DORIS double storage ring is briefly reviewed, followed by a short discussion of the two magnetic spectrometers which are scheduled to operate in 1974. The use and limitation of a tagging system installed along the S. R. beams is discussed. (auth)

Experimental Facilities

Refer also to abstracts 26760, 26930, 27146–27148, 27158, and 27165.

27460 (ORNL-TM-4527) FLIGHT PATH 7 NEUTRON CAPTURE CROSS SECTIONS: DATA ANALYSIS PROGRAMS. Macklin, R. L. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7415-eng-26. 9p. Dep. NTIS $4.00.

The use of data analysis programs for the calculation of neutron capture cross sections at the ORELA neutron time-of-flight facility is briefly described. (RWR)

27461 (RL-73-137) REMARKS ON NEUTRINO FLUXES AND THEIR MEASUREMENT IN 200 AND 400 GeV NEUTRINO EXPERIMENTS USING WIDE-BAND AND NARROW-BAND BEAMS. Venus, W. A.; Wachsmuth, H. W. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). 16 Oct 1973. 39p. Dep. NTIS (U. S. Sales Only) $4.00.

The discussion covers 200 to 400 GeV compatibility of the CERN-SPS-West Area layout, ν_μ, ν_e, and μ fluxes in wide-band beams, narrow-band beams, and neutrino spectrum determination. (JFP)

27462 BROOKHAVEN LINAC ISOTOPE PRODUCER (BLIP). Richards, P.; Lebowitz, E.; Stang, L. G. Jr. (Brookhaven National Lab., Upton, NY). pp 325-341 of Radiopharmaceuticals and Labeled Compounds. Vol. I. Vienna; International Atomic Energy Agency (1973).

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973). See STI/PUB-344(Vol.1); CONF-730309-P1.

During the next few years multi-purpose, high-current linear accelerators (Linacs) that produce >50-MeV particles will have a significant impact on radionuclides and radiopharmaceuticals available to nuclear medicine. Such machines can produce simultaneously several radionuclides in large quantities and at a relatively low cost. The first facility to explore the radionuclide production potential of such a linear accelerator is the Brookhaven Linac Isotope Producer (BLIP), which began preliminary operation in the autumn of 1972. The BLIP serves as a beam stop and utilizes the excess beam capacity of a proton Linac that injects protons into the Alternating Gradient Synchrotron, which is used in high-energy physics research. The Linac generates up to 10 pulses of 200-MeV protons per second, providing a time-averaged beam current of ~180 μA for radioisotope production. This high current and the fact that the machine normally operates 24 hours per day, 7 days per week, make it feasible and economical to produce curie quantities of many short- and medium-lived radionuclides as well as useful quantities of relatively long-lived materials. The proton beam enters the BLIP irradiation chamber under 32 ft of water. The water serves as a flexible, transparent shield for high-energy neutrons that are produced by proton interactions with target materials. Guide tubes are used for introducing ten independent target assemblies into the proton beam and for transferring targets out of the BLIP for transport to disassembly and processing facilities. As the proton beam traverses an array of targets it is degraded in energy. This makes it possible to select energy ranges for maximum production of the desired product in the most suitable target with a minimum yield of impurities. The development of necessary technology is underway for the production of a number of radionuclides that are expected to yield important new radiopharmaceuticals and applications in nuclear medicine. Preliminary studies have confirmed the target design, calculated yields, and purity for the production of ^{123}I, ^{127}Xe and ^{52}Fe. Work is starting on a number of other potentially important medical radionuclides including ^{97}Ru, ^{97m}Tc, ^{82}Sr and ^{179}Ta. (auth)

27463 CRYOPUMPED, CONDENSED HYDROGEN JET TARGET FOR THE NATIONAL ACCELERATOR LABORATORY MAIN ACCELERATOR. Bartenev, V. (Inst. of High Energy Physics, Serpukhov, USSR); Kuznetsov, A.; Morozov, B.; Nikitin, V.; Pilipenko, Y.; Popov, V.; Zolin, L.; Carrigan, R.; Klen, J.; Malamud, E.; Strauss, B.; Sutter, D.; Yamada, R.; Cool, R.; Olsen, S.; Goulianos, K.; Chiang, I. H.; Gross, D.; Melissinos, A. Advan. Cryog. Eng.; 18: 460–466(1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

A jet target designed to carry out proton–proton interaction experiments in the inner beam of the NAL Synchrotron is described. The target produces a pulsed jet of condensed hydrogen with a 10 mm diameter, a 300 ms duration, and a density of 10^{-6}g/cm^3. The jet is pumped from the vacuum chamber with a helium-cooled cryopump. The system is described and the operating parameters are listed. (WHK)

27464 CALCULATIONS OF EFFUSIVE-FLOW PATTERNS. II. Scattering Chambers with Semi-Infinite Slits. Nelson, R. N. (Georgia Southern Univ., Statesboro); Colgate, S. O. Phys. Rev., A; 8: No. 6, 3045-3049(Dec 1973).

The method presented in the first paper of this series for computing distributions in steady-state effusive flows was applied to beam-scattering chambers of especially simple geometry having identical long, narrow slits of negligible channel length. The results are presented as correction factors α which, when multiplied by the chamber length, give the effective length of scattering path through an attenuating medium of uniform density equal to that in the scattering-gas source. Predictions of the calculations compare well with scattering measurements made with a chamber of variable length. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstract 27790.

27465 SPACE DISTRIBUTION FUNCTION OF ELECTRON–PHOTON SHOWER PARTICLES IN ISOTHERMAL ATMOSPHERE. Guzhavin, V. V.; Ivanenko, I. P.; Paskhalov, Yu. I. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 5, 523-527(1973). (In Russian).

The space distribution functions of shower electrons at different depths of evolution of the electron–photon shower in isothermal atmosphere were calculated by the method of moments. The calculations of the space moments were carried out by formulas calculating the precise dependence of the moments on the depth t. (1 table) (tr-auth)

27466 SEARCH FOR CORRELATIONS IN THE ARRIVAL TIMES OF EXTENSIVE AIR SHOWERS AND WEBER GRAVITATIONAL WAVES. Kanofsky, A. (Department of Physics, Lehigh University, Bethlehem, Pennsylvania 18015); Tutin, M.; Kanofsky, P. Phys. Rev. D 8: No. 12, 4233-4240 (15 Dec 1973).

We have searched for correlations in the arrival times of extensive air showers and Weber gravitational waves. Extensive air showers with energies greater than 5×10^{14} eV were detected at the Jadwin Physics Building, Princeton, New Jersey, from March to November 1971. The apparatus was not sensitive to cosmic rays coming directly from the galactic center. The shower-arrival times were compared to the arrival times of Weber's gravitational waves occurring over the same period. Undelayed and delayed time coincidences were checked for in the analysis, as well as possible time-delay dispersion effects. (auth)

27467 GAS-RICH METEORITES: POSSIBLE EVIDENCE FOR ORIGIN ON A REGOLITH. Macdougall, D.; Rajan, R. S.; Price, P. B. (Univ. of California, Berkeley). Science; 183: No. 4120, 73-74(11 Jan 1974).

The asymmetry of irradiation features of grains in the Kapoeta and Fayetteville meteorites suggests irradiation on a regolith before meteorite formation. Chondrules and broken grains require approximately 10^4 years of irradiation time between formation or fracturing and compaction into the meteorite. Shock erasure of tracks from irradiated Kapoeta feldspars requires a severe shock event during or after meteorite formation. (auth)

27468 NEUTRAL INTERSTELLAR HYDROGEN AND EXTRATERRESTRIAL LYMAN ALPHA RADIATION. Blum, P. W. pp 879-884 of Space Research XIII. Vol. 2. Berlin; Akademie–Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

The extraterrestrial Lyman-alpha radiation is composed of two components. The major part of the radiation is solar Lyman-alpha scattered by interplanetary hydrogen. It has an anisotropic distribution. The other component is of galactic origin and is probably isotropic. The total extraterrestrial Lyman-alpha radiation was monitored by several satellite-borne experiments, mainly on OGO 5. Their results are analyzed, and an estimate is derived from these observations for the galactic component and the density and direction of flow of the interstellar medium in the vicinity of the solar system. The interstellar density so estimated does not deviate appreciably from estimates by other methods. (auth) (IAA)

27469 EFFECT OF IONIZATION LOSSES ON COSMIC RAY CONCENTRATION IN THE EXPANDING UNIVERSE. Velinov, P. I. (Inst. of Geophysics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 8, 1037-1040(1973).

Consideration is given to the effects of ion losses, associated with the expansion of the Universe, on the spectrum, composition, and intensity of metagalactic cosmic rays outside the boundaries of the Galaxy. Expressions are given to estimate such effects. The magnitude of ion losses in the metagalactic space is found to be considerable. (IAA)

27470 ANALYSIS OF THE ENERGY SPECTRUM OF NEAR VERTICAL MUONS ABOVE 3 (10^{11}) eV. Ng, L. K.; Wolfendale, A. W. (Univ. of Durham, Eng.). Nuovo Cim.; 20B: No. 1, 161-172(11 Mar 1974).

Available data from a variety of cosmic-ray experiments are compared and analyzed to give a best estimate of the integral spectrum of near vertical muons in the energy range $3 \cdot 10^{11}$ eV $< E_\mu < 5 \cdot 10^{13}$ eV. The data appear consistent with muons having been derived mainly from pions produced with a differential energy spectrum having an exponent $\gamma_\pi = 2.70 \pm 0.03$. (auth)

Stars

Refer also to abstracts 27722, 28372, 28382, and 28383.

27471 TEMPERATURE DISTRIBUTION IN A GRAY STELLAR ATMOSPHERE. Tanasescu, E. (Institutul Politehnic, Bucharest). Stud. Cercet. Astron.; 18: No. 2, 209-212(1973). (In Rumanian).

An approximate method is presented for deducing the temperature distribution in a gray stellar atmosphere. The computations prove that the weight of an exact solution on Chandrasekhar's second approximation provides better results than Chandrasekhar's fourth approximation. (auth)

27472 COMPUTER PROGRAM FOR THE IMPROVEMENT OF THE PRELIMINARY ELEMENTS OF THE ECLIPSING VARIABLE STARS. Application to the HO Telescopii System. Minti, H. (Observatorul Astronomic, Bucharest). Stud. Cercet. Astron.; 18: No. 2, 193-204(1973). (In Rumanian).

An algorithm used for the improvement of the preliminary elements of the eclipsing binaries is proposed. (WDM)

27473 FINE CHANGES IN THE LIGHT CURVE OF A VARIABLE STAR. Todoran, I. (Astronomical Observatory, Cluj). Stud. Cercet. Astron.; 18: No. 2, 171-178(1973).

Taking into account that the period of a variable star is the time interval after which the corresponding light-curve is repeated, a method for the study of its fine changes is examined. Practical applications for V 477 Cygni and RZ Cephei are presented. (auth)

27474 STUDY OF 4 RR LYRAE TYPE VARIABLES. I. RU and SV Bootis. Chis, G.; Chis, D.; Mihoc, I. (Observatorul Astronomic, Cluj). Stud. Cercet. Astron.; 18: No. 2, 139-145 (1973). (In Rumanian).

Results of the photographic observations of the RU and SV Bootis variable stars are reported. The observations were carried out at the Astronomical Observatory of the University of Cluj, during the 1959–1965 period. Photometric elements are given. (auth)

27475 ABSORPTION OF RADIATION THROUGH PHOTOIONIZATION IN A MAGNETIC FIELD. Pavlov, G. G. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Astron. AJ (Engl. Transl.); 17: No. 2, 209-212(1973).

Translated from Astron. Zh.; 50: No. 2, 320-326(1973).

The absorption coefficient for photoionization in a magnetic field is calculated. The frequency dependence of the photoionization cross section exhibits peaks, which are uniformly spaced at an interval equal to the Larmor frequency. In the neighborhood of the peaks the absorption coefficient differs for radiation with different polarization parameters. The height of the peaks depends on the angle between the magnetic field and the direction of propagation of the radiation being absorbed. This effect might be observable in stellar atmospheres whose magnetic-field strength is several thousand gauss or more. (auth)

27476 COPLANAR SYSTEM OF BINARY STARS IN AQUILA. Radzievskii, V. V.; Radievskaya, E. V. (Gorky Teachers' Coll., USSR). Sov. Astron. AJ (Engl. Transl.); 17: No. 2, 239-241(1973).

Translated from Astron. Zh.; 50: No. 2, 371-376(1973).

A region in the constellation Aquila has been discovered, bounded by galactic coordinates $28°30' < l < 71°$, $-9° < b < 18°30'$, that contains 36 visual binaries with determined orbits, 32 of which are retrograde. The pole of coplanarity of this system ($l = 55°$, $b = 7°$), the coplanarity coefficient (0.70), and the probability that the distribution is random are established. "Territorial" and kinematical considerations suggest that the solar system itself belongs to the system. Several questions that arise are posed. (auth)

27477 POSSIBLE NEW GLOBULAR CLUSTERS IN THE ANDROMEDA NEBULA. Sharov, A. S. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 17: No. 2, 174-178(1973).

Translated from Astron. Zh.; 50: No. 2, 263-269(1973).

Twenty-five diffuse objects in the neighborhood of the Andromeda Nebula with V magnitudes of 15.6 to 18.2 m and color indices $B - V < 1.0$ m were identified on plates taken with the Schmidt telescope of the Latvian Radio Astrophysical Observatory at Baldone. The objects are definitely concentrated toward the galaxy and represent possible new globular clusters belonging to the system. (auth)

27478 BINARY MODEL FOR THE SYMBIOTIC STAR AG PEGASI. Cowley, A.; Stencel, R. (Univ. of Michigan, Ann Arbor). Astrophys. J.; 184: No. 2, 687-692(1 Sep 1973).

Measurements of the radial velocity of the underlying M giant absorption spectrum in AG Peg reveal a small-amplitude varia-

tion with P = 830.14 days. The emission lines of this symbiotic star are found to vary in antiphase with the absorptions and probably arise mainly around the hot secondary star. Variations in the number of emission lines and the strength of the M star may be due to partial occultations of each component by the other. Gas streaming distorts the emission velocity, so it is difficult to determine the exact mass ratio. It is shown that if the M giant is not more massive than 6 $M_{\odot}$, then the mass of the emission object falls between 1 and 1.5 $M_{\odot}$. (auth)

27479 DETERMINATION OF THE S-PROCESS NEUTRON CAPTURE TIME. Peterson, V. L. (Utah State Univ., Logan); Tripp, D. A. Astrophys. J.; 184: No. 2, 473-492(1 Sep 1973).

The relative abundance that an isotope or element attains during the s-process depends critically, in many cases, upon the mean neutron capture time, τ_n. The latter is very poorly known, however, with estimates ranging over a factor of 10^4 for a particular isotope. It is shown that it may be possible to determine τ_n for a given isotope and star from observations. The relative abundances of all the isotopes that participate in the s-process were calculated as a function of τ_n, under steady-state conditions. The assumption of steady state is not critical as long as attention is confined to ratios of abundances of elements which are adjacent in the periodic table. Processes were also included which may alter the effective β-decay lifetime, such as the photo-beta process, and it is found that the effects on elemental abundance ratios are negligible. The calculations can be applied in a variety of ways. For example, in some highly evolved stars, material processed in the interior is apparently transported to the surface in such quantities as to completely dominate the atmospheric abundances of the heavy elements. In principle, one should be able to determine τ_n for a given isotope for such a star by comparing observations with these calculations. With few exceptions, this does not appear possible as yet since the spectra of such stars are notoriously difficult to interpret. For R Cyg, however, Zr isotopic abundance observations rule out both very small and very large values of τ_n. For solar-system material, examination of the abundance of isotopes produced only by the s-process indicates that τ_n was probably on the order of 10 years. (auth)

27480 VARIABLE STARS. Strohmeier, W. International Series of Monographs in Natural Philosophy. Volume 50. Elmsford, NY; Pergamon Press, Inc. (1972). 286p. $19.50.

The physical and geometrical factors which influence the behavior of the group of stars known as "variable stars" are examined. Although primary concern is with light variations in the optical region, parallel fluctuations in the intensity of radio emission are also dealt with and the results of high-altitude techniques for observing temporal changes in the physical characteristics of other groups of variable stars are discussed. (WDM)

27481 DETAILED PHOTOMETRIC STUDY OF THE CEPHEID RT AUR. Winzer, J. E. (Univ. of Toronto). Astron. J.; 78: No. 7, 618-621(Sep 1973).

Differential UBV observations with a time resolution of approximately 1 h and an accuracy of approximately 0.01 mag are presented for the Cepheid RT Aur. The light curves are sufficiently accurate to show fine structure as predicted by recent Cepheid models. An apparent period change of 0.00022 days has been noted. Evidence is presented to indicate that the period has undergone several changes in the past 20 yr. (auth)

27482 PHOTOELECTRIC PHOTOMETRY OF ST AQUARII. Gleim, J. K. (Univ. of Florida, Gainesville). Astron. J.; 78: No. 7, 622-627(Sep 1973).

Three-color observations were made of the eclipsing binary ST Aquarii and a study of the system based on the Russell model showed the two components to be undergoing partial eclipses (i = 79°). The larger star (A7) is eclipsed at primary minimum (transit), has about twice the radius of the smaller (G8), and contributes over 95% of the light to the system. There has been some evidence in the past for a variability in the period and this is not contradicted by the times of minimum in this paper. (auth)

27483 ANGULAR DIAMETER OF R LEONIS. Nather, R. E. (Univ. of Texas, Austin); Wild, P. A. T. Astron. J.; 78: No. 7, 628-631(Sep 1973).

A lunar occultation of the long-period red variable R Leonis was observed with the 18-in. refractor of the South African Astronomical Observatory in Cape Town on May 19, 1972. The measured uniform disk diameter of the star is 0.067 arcsec, with a formal uncertainty of ±0.005. This diameter is in agreement with the value calculated from the UBV colors of the star, and with the radiometric measurements by Pettit and Nicholson made in the early 1920's. (auth)

27484 ORBIT AND MASS OF THE VISUAL BINARY L 726-8. Worley, C. E.; Behall, A. L. (Naval Observatory, Washington, DC). Astron. J.; 78: No. 7, 650-653(Sep 1973).

New observations permit a redetermination of the orbit of the red dwarf binary L 726-8. The resulting masses, assuming a reasonable mass-ratio, are $0.12_{\odot}$ and $0.10_{\odot}$; these values are about 2(½) times larger than those heretofore quoted. Consequently, it appears likely that the components are normal hydrogen-burning stars on the main sequence. (auth)

27485 PROBLEMS AND ACHIEVEMENTS OF NUCLEAR ASTROPHYSICS. III. Slow Neutron Capture in Stars. Kuchowicz, B. (Univ. of Warsaw). Postepy Fiz.; 24: No. 6, 669-690 (1973). (In Polish).

Recent ideas on the mechanism of nucleosynthesis of the majority of heavy nuclides (with mass numbers above 65) are outlined. Arguments based on theory and on correlations between neutron capture cross sections and nuclidic abundances point in favor of slow neutron capture (with beta decays between some of the capture processes) as the mechanism which is responsible for the production of the chemical elements between the iron group and bismuth. (auth)

27486 HARD X-RAYS FROM COMA CLUSTER AND VIRGO CLUSTER. Bui-Van, A.; Vedrenne, G. (Univ., Toulouse). pp 855-857 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

An attempt was made to obtain some information on the angular extent of the X-ray extragalactic sources Coma Cluster and Virgo Cluster. Signals in the energy range from 20 to 150 keV are obtained by addition of counting rates from source scans and pointing mode. But it is probably better to consider these measurements as upper limits until more sensitive high-energy data become available. (auth) (IAA)

27487 ULTRAVIOLET STELLAR SPECTRA OBTAINED WITH THE UTRECHT ORBITING STELLAR SPECTROPHOTOMETER S 59 ABOARD THE ESRO TD-1 A SATELLITE. Hoekstra, R.; van der Hucht, K. A.; de Jager, C.; Kamperman, T.; Lamers, H. J. (State Univ., Utrecht). pp 871-877 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

27488 STUDY OF FOUR RR LYRAE TYPE VARIABLES. I. RU and SV Bootis. Chis, G.; Chis, D.; Mihoc, I. (Observatorul Astronomic, Cluj). Stud. Cercet. Astron.; 18: No. 2, 139-145 (1973). (In Rumanian).

27489 EXTENDED SHELLS OF ANDROMEDA Z TYPE STARS. Gorbatskii, V. G.; Ivanov, L. N. Vestn. Leningrad. Univ., Mat., Mekh., Astron.; 144-152(Jul 1973). (In Russian).

Consideration is given to the effect of an extended shell of the "hot" star in the Z And system on the continuous spectrum of the star, and determination of the characteristics of the star and the shell from observations of the spectrum. The electron temperature in an extended shell is shown to be close to 10,000 K. The stellar magnitude of the "cold" star in the Z And system amounts to 2 to 3 mag. The brightness variations of the system may be explained by assuming that the outflow of matter from the "hot" star is variable. It is also shown that the strong [Fe VII] lines frequently present in the spectrum of Z And may arise as a result of the interaction between outflowing matter and the circumstellar shell. (IAA)

27490 SEARCH FOR EXTREMELY RED STARS ON THE PALOMAR OBSERVATORY SKY SURVEY. Dorschner, J.; Friedemann, C.; Guertler, J. (Univ., Jena, Ger.). Astron. Nachr.; 294: No. 4, 153-158(1973).

In the investigation a number of fields distributed over a large range of galactic latitudes was searched for extremely red stars using reproductions made from the blue and red Palomar Observatory Sky Survey (POSS) prints. The search was conducted by superimposing reproductions of the blue and red POSS charts on photographic plates. Positive transparencies showing the stars dark on a bright background were made from the blue, and negative transparencies were obtained from the red prints. (IAA)

27491 PHOTOMETRIC AND SPECTROGRAPHIC OBSERVATIONS OF THE MAGNETIC STAR HD 98088. Hildebrandt, G.; Nikolow, A. S.; Scholz, G.; Schoeneich, W. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Astron. Nachr.; 294: No. 4, 175-178(1973). (In German).

27492 STRUCTURE OF INTERSTELLAR MATTER AROUND ZETA PERSEI. Kuehn, L. (Univ., Jena, Ger.). Astron. Nachr.; 294: No. 4, 159-174(1973). (In German).

Spectra of zeta Persei were obtained with the Coudé-grating spectrograph of a 2-m reflecting telescope. Other spectra were

determined with the aid of a Cassegrain spectrograph. A Gaussian analysis is conducted for 12 line profiles. The radial velocities of Ca ions and Na ions are compared with the velocities of the hydrogen atoms. Aspects of gaseous density and the abundances of Na and Ca are discussed. The interstellar dust component is considered together with the results of photographic three-color photometry, interstellar polarization, and structure analysis. (IAA)

27493 CARBON DEPLETION IN THE ENVELOPES OF MAIN SEQUENCE STARS. Paczynski, B. (Inst. of Astronomy, Warsaw). Acta Astron.; 23: No. 3, 191-196(1973).

It is shown that meridional (Eddington-Vogt) circulation in the envelopes of rotating main-sequence stars may bring up to the stellar surface nitrogen produced from carbon in the CNO bi-cycle. The required nuclear reactions take place outside the convective core, in a region where there is no mu gradient that could suppress the meridional circulation. Carbon depletion was calculated for the envelopes of model main-sequence stars in the mass range from 0.8 to 60.0 solar masses, and an initial composition: X = 0.7, Z = 0.03. Carbon depletion was unimportant in the 0.8 and 1.5 solar mass models. In the 3 solar mass model the carbon to nitrogen ratio decreased to 1:200 within the main-sequence lifetime of that model. A large carbon depletion was also obtained in the models of 5, 7, and 10 solar masses. In the models of 15, 30, and 60 solar masses carbon depletion was unimportant. (IAA)

27494 EVOLUTION OF THE SYSTEM OF BINARY STARS IN A STAR FIELD. Agekyan, T. A.; Anosova, Zh. P. Vestn. Leningrad. Univ., Mat., Mekh., Astron.; No. 3, 138-143(Jul 1973). (In Russian).

The kinetic equation describing the evolution of the number of binary stars in a star field is found. The processes of the formation of binaries in random triple encounters of single stars and the disintegration of binary stars due to interactions with the field stars are taken into account. The coefficients of the equation are obtained by using the results of the earlier investigations of the above-mentioned processes by the Monte-Carlo method. The numerical solution of the equation is obtained. It gives the relative number of binary systems as a function of time t under several assumptions as regards the starfield and for two initial conditions: the fraction of binary stars is a) zero and b) 0.1. As $t \to \infty$, the number of binaries tends to that by characteristic if dissociative quasi-equilibrium. The equilibrium fraction of binaries is $\sim 10^{-15}$ in the neighborhood of the Sun, $\sim 10^{-9}$ in globular clusters, and $\sim 10^{-3}$ in open star clusters, which essentially means that in the state of dissociative quasi-equilibrium the binaries must be absent. (auth)

27495 EXTENDED ENVELOPES OF Z AND-TYPE STARS. Gorbatskii, V. G.; Ivanov, L. N. Vestn. Leningrad. Univ., Mat., Mekh., Astron.; No. 3, 144-152(Jul 1973). (In Russian).

The "hot star" in the system of Z And and in similar ones must have an extended envelope because of the observed outflow of matter from the star. Some effects of such an envelope on the spectrum are considered and parameters of the star and the envelope are found. The electron temperature in the envelope is close to 10^4°K. It is shown using the spectral data that the "cold star" in the system of Z And has $M \approx +2^m, +3^m$. Light variations of the system may be attributed to the variable outflow of matter from the "hot star", the other factors are less important. It is also shown that [Fe VII] lines in the spectrum of Z And may be caused by the interaction of the outflowing matter with the circumstellar envelope. (auth)

27496 POLARIMETRIC OBSERVATIONS OF THE NEBULA NEAR RY TAU. Yakovleva, V. A. Vestn. Leningrad. Univ., Mat., Mekh., Astron.; No. 3, 168-169(Jul 1973). (In Russian).

The results of polarimetric photographic observation of the nebula near RY Tau are given. B96 is the reflection nebula. (auth)

27497 PHOTOEFFECT IN STRONG MAGNETIC FIELDS AND THE X-RAYS FROM NEUTRON STARS. Gnedin, Yu. N.; Pavlov, G. G.; Tsygan, A. I. (Ioffe Inst. of Physics and Tech., Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 2, 421-432(Feb 1974). (In Russian).

The cross section for photoabsorption of x rays with arbitrary polarization incident on a hydrogen-like atom in a strong magnetic field at arbitrary angles is obtained. For energies of several keV the photoeffect cross section is $\sim 10^{-22}$ to 10^{-20} cm^2 which appreciably exceeds the photoeffect cross section in the absence of a magnetic field as well as the cross section for scattering and bremsstrahlung absorption by electrons of the thermal plasma ($T \sim 10^8$ to 10^{10}°K) in a magnetic field. An equation for ionized equilibrium in a magnetized plasma is found and it is shown that the magnetic field may either enhance or reduce the degree of ionization depending on the temperature T. Due to the large magnitude of the photoionization cross section in a magnetic field, photorecombination may be the major source of release of thermal energy by the plasma of neutron stars with temperatures $T \sim 10^6$ to 10^{7}°K. Its intensity in the soft x-ray region exceeds that of the electron bremsstrahlung radiation by several times for transverse propagation and by more than an order of magnitude for longitudinal propagation. The peculiarities of atomic structure in magnetic fields may lead to the appearance of discontinuities in the neutron star spectrum which lie in the soft x-ray range. For quanta with energies $\hbar\omega < 3$ keV the characteristics of the neutron star radiation may be determined by photoionization and photorecombination processes. In this case the x-ray radiation is not directed. (auth)

27498 SUPERCONDUCTIVITY IN ASTROPHYSICS. de Cesare, L. (Osservatorio Astronomico, Naples). Soc. Astron. Ital., Mem.; 44: 279-303(1973).

After some general considerations on superconductivity the possible astrophysical systems in which the superconducting phenomenon can occur are discussed. The superconductivity in large planets, in white dwarf stars, and in neutron stars is considered in some detail with some possible astrophysical implications. A survey is given of some noteworthy superconductive effects which arise in gravitational fields under laboratory conditions; an extension of these results to the astrophysical field is proposed. (auth)

27499 TEST ON THE SHELL HOMOLOGY RELATIONS. Dallaporta, N.; Malagnini, M. L. (Univ., Padua). Soc. Astron. Ital., Mem.; 44: 213-230(1973).

Analytical relations (shell homology relations) are derived for a stellar model describing the behavior of an 11 solar mass star, with H-burning in the shell and central He-burning, in thermal equilibrium. Four different approximations, related to the variations of the mass and radius of the core only (Refsdal and Weigert case), or to the luminosity of the core, the radiation pressure, and the chemical composition are considered. The analytical predictions are compared with an evolutionary sequence of models. There is a generally good qualitative (and in some cases quantitative) agreement; moreover, the different approximations do not yield appreciable modifications with respect to the simplest Refsdal and Weigert case. (auth) (IAA)

27500 PROBLEM OF STAR FORMATION UNDER CONDITION OF MARGINAL STABILITY. Ferraioli, F.; Virgopia, N. (Osservatorio Astronomico, Rome). Soc. Astron. Ital., Mem.; 44: 181-191(1973).

The process of star formation in an isothermal contracting interstellar cloud of neutral atomic hydrogen, endowed with rigid rotation and permeated by a uniform magnetic field, is studied. It is assumed that the condition of marginal stability is also valid for the self-gravitating fragments. The radius of the initial gas sphere has been computed in several cases with the initial magnetic field associated with the cloud. Extreme values have also been found for the initial magnetic field strength of the cloud and for the density and radius of the fragments. The collision time of the components has been found to be sufficiently longer than the contraction time, so that coalescence by gravitational forces among the fragments may generally be overcome. Conservation of angular momentum makes the fragments very-high-speed rotators when their radius reduces to the solar radius. The condition of rotational stability reduces angular momentum by significant factors and reduces the angular rotation to plausible values. (auth) (IAA)

27501 DAMPING LAW OF EXTERNAL FIELDS OF A COLLAPSING BODY. Patashinskii, A. Z.; Pinus, V. K.; Khar'kov, A. A. (Inst. of Atoms and Electrons, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 66: No. 2, 393-405(Feb 1974). (In Russian).

The laws of variation of electromagnetic and gravitational fields in the space surrounding a collapsing star are obtained. At large distances the exponential front is followed by a power decay law of the form $1/r\tau^{l+2}$ where τ is the time at the given point after traversal of the exponential front. The duration of validity of the power law depends on the distance R at which the gravitational field of the collapsar is comparable to the fields of the surrounding bodies. In the idealized case when the collapsing star is the only source of a gravitational field the duration of operation of the law is equal (in light units) to the distance r from the point of observation. After a time $\tau \sim r/c$ the residual field in this idealized case relaxes according to the law t^{-2l-2}. The same law is valid for relaxation of fields at distances $r \sim r_g$. The appearance of tails at steep wave packet fronts with a power damping law is a general property of wave traversal through the space curvature barrier created by the gravitating mass. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 28598.

27502 HIGH-RESOLUTION SURVEY OF THERMAL RADIO SOURCES AT 8.2 mm. Berulis, I. I.; Sorochenko, R. L. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 17: No. 2, 179-186(1973).

Translated from Astron. Zh.; 50: No. 2, 270-282(1973).

Thermal radio sources were surveyed with the 22-m radio telescope at 8.2-mm wavelength with 1.9 resolution. Positions, sizes, and other physical parameters were determined for 26 individual sources. These sources have a very high surface brightness (EM $\approx 10^6$ pc/cm^6) and mean electron density ($N_e \approx 10^3$ cm^{-3}). In the future a further resolution of sources into separate components may be expected in distant H II regions. (auth)

27503 EXPECTED RADIATIVE VARIABILITY OF CRAB NEBULA PULSAR NP 0532, RELATED TO ABRUPT CHANGES IN ANGULAR VELOCITY. Ozernoi, L. M.; Usov, V. V. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 17: No. 2, 270-271(1973).

Translated from Astron. Zh.; 50: No. 2, 422-424(1973).

Sudden sharp changes in the angular velocity of rotation of pulsar NP 0532 can apparently be explained by the variability of its magnetosphere. In the presence of low-frequency magnetodipole radiation outside the "light cylinder" of the pulsar, plasma being ejected from its magnetosphere would disperse and be accelerated by the low-frequency wave. Accelerated electrons would radiate in the field of the low-frequency wave, by the synchrotron mechanism. The radiation maximum, as is to be expected, would be displaced from the infrared into the millimeter region. Compton scattering of this radiation by the same electrons can be observed in the gamma-ray region with energies of the order of 100 MeV for a short time after an abrupt change in angular velocity. A proposed combination radio–gamma tests is expected to verify both the explanation of the abrupt changes in the pulsar's rate of rotation by a recurrent instability of its magnetosphere, and the presence of magnetodipole radiation far away from the pulsar. (auth)

27504 POSSIBLE EXPLANATION OF QUASAR STABILITY BASED ON THE HYPOTHESIS OF THE EXISTENCE OF SHORT-ACTING REPULSIVE FORCES. Nedyalkov, I. P. (Joint Center of Physics and Physical-Mechanical Problems, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 9, 1159-1162(1973). (In Russian).

An attempt is made to explain the stability of quasars by means of some generalizations of the general theory of relativity. This generalization is characterized by the fact that it leads to the existence of short-acting repellent forces. It is shown that if the mean density of the quasar is less than some critical value then equilibrium does not exist. (JSR)

27505 OPTICAL IDENTIFICATIONS OF RADIO SOURCES USING ACCURATE RADIO AND OPTICAL POSITIONS. Wills, B. J.; Wills, D.; Douglas, J. N. (Univ. of Texas, Austin). Astron. J.; 78: No. 7, 521-535(Sep 1973).

The first results of a program of optical identification of several thousands of radio sources based on the sole criterion of coincidence of accurate radio and optical positions are presented. Radio positions of ~1 arcsec accuracy for 605 radio sources have already been published by Douglas, Bash, Ghiho, Moseley, and Torrence (1973), who give further details of the overall program. Optical positions are given for 181 objects near some of these and other radio sources, measured with typical rms accuracy of 0.5 arcsec. Of 145 objects within 10 arcsec of the radio positions measured by Douglas et al., 81 are within 3 arcsec, including 38 spectroscopically confirmed QSOs, 15 additional blue stellar objects, and 15 galaxies. Finding charts are given for 43 objects which are within 3 arcsec of the radio positions (5 arcsec for galaxies and blue stellar objects) and for which finding charts do not exist in the literature. The reliability of these new identifications, based on position coincidence alone, is approximately 95%. A number of previously suggested identifications have been rejected on the basis of the new and more accurate radio and optical positions. (auth)

27506 CORRELATION EFFECTS IN PION CONDENSATES. Weise, W.; Brown, G. E. (State Univ. of New York). Phys. Lett.; 48B: No. 4, 297-301(18 Feb 1974).

The threshold for pion condensation in neutron star matter is estimated on the basis of a sufficiently realistic treatment of effective forces. It turns out that the short range repulsion of the nucleon–nucleon force raises considerably the density at which the pion condensed phase can occur. (auth)

27507 RATIO STARS. Friedemann, C. Astron. Raumfahrt; No. 4, 97-103(1973). (In German).

The possibilities for the detection of stellar radio emission are examined, giving attention to problems connected with the existence of terrestrial noise sources and approaches to overcome these problems. The classes of radio stars and their characteristics are discussed, taking into account flare stars, red supergiants, physical binary systems, novae, and pulsars. Aspects of stellar line spectra in the radio frequency range are also considered. (IAA)

27508 RESULTS OF A SEARCH FOR 10^{12} eV GAMMA RAYS FROM PULSARS. Jennings, D. M.; White, G.; Porter, N. A.; O'Mongain, E.; Fegan, D. J.; White, J. (University Coll., Dublin). Nuovo Cim.; 20B: No. 1, 71-82(11 Mar 1974).

A fast night-sky Cherenkov detector has been used in a search for γ rays of energy 10^{12} eV from ten pulsars. Observations were made at a site in Malta during the years 1969-70. No strong evidence for continuous emission was found, and the upper flux limits are given. Analysis for γ rays pulsed at the pulsar period shows an anomalous effect from the Crab Nebula, which may correspond to a true flux. On other pulsars no evidence was found for emission at the pulsar periods. (auth)

Solar Phenomena

Refer also to abstracts 27541, 27558, and 28596.

27509 FINE STRUCTURE OF INTERPLANETARY PLASMA VELOCITIES. Lotova, N. A.; Chashei, I. V. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 17: No. 2, 226-230(1973).

Translated from Astron. Zh.; 50: No. 2, 348-356(1973).

An analysis is made of how the regular directed-velocity spectrum of interplanetary irregularities affects the scale of the diffraction pattern of radio-source scintillations. If at least two characteristic velocities are present with approximately the same power spectrum, the cross-correlation function of the intensity fluctuations will have a larger scale than the autocorrelation function. The fine structure of the velocity of the irregularities can be determined by observing scintillations at two or more stations, but cross-correlation analysis cannot distinguish whether this structure is associated with random or regular velocity components. (auth)

27510 SUPERHEATED FLOW INSTABILITY OF ELECTRIC-CONDUCTING GAS IN TRANSVERSE MAGNETIC FIELD AT $Re_m \gg 1$ AND POSSIBLE EXPLANATION OF NATURE OF CHROMOSPHERE FLARES ON THE SUN. Sokolov, V. S. (Inst. of Theoretical and Practical Mechanics, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk; No. 13, 86-96(Oct 1973). (In Russian).

The results of laboratory experiments on the superheated flow instability of an electroconducting gas in a transverse magnetic field are used to derive a model for chromosphere flares on the Sun. (JSR)

27511 INTERPLANETARY SHOCK WAVES GENERATED BY SOLAR FLARES. Dryer, M. (National Oceanic and Atmospheric Administration, Boulder, CO). Space Sci. Rev.; 15: No. 4, 403-468(Feb 1974).

Recent observational and theoretical studies of interplanetary shock waves associated with solar flares are reviewed. An attempt is made to outline the framework for the genesis, life, and demise of these shocks. Thus, suggestions are made regarding their birth within the flare generation process, MHD wave propagation through the chromosphere and inner corona, and maturity to fully-developed coronal shock waves. Their subsequent propagation into the ambient interplanetary medium and disturbing effects within the solar wind are discussed within the context of theoretical and phenomenological models. The latter—based essentially on observations—are useful for a limited interpretation of shock geometric and kinematic characteristics. The former—upon which ultimate physical understanding depends—are used for clarification and classification of the shocks and their consequences within the solar wind. Classification of limiting cases of blast-produced shocks (as in an explosion) or longer lasting ejecta (or "piston"-driven shocks) will hopefully be combined with the study of the flare process itself. The theoretical approach, in spite of its contribution to clarification of various concepts, contains some fundamental limitations and requires further study. Numerical simulations, for example, depend upon a nonunique set of multi-parameter initial conditions at or near the Sun. Additionally, the subtle but important influence of magnetic fields upon energy transport processes within the solar wind has not been considered in the numerical simulation approach. Similarity solutions are limited to geometrical symmetries and have not exploited their potential beyond the special cases of the blast and the constant-velocity, piston-driven shock waves. These continuum fluid studies will probably require augmentation or even replacement by plasma kinetic theory in special situations when observations indicate the presence of anomalous transport processes. Presently, for example, efforts are directed

toward identification of detailed shock structures (as in the case of Earth's bow shock) and of the disturbed solar wind (such as the piston). Further progress is expected with extensive in situ and remote monitoring of the solar wind over a wide range of heliographic radii, longitudes, and latitudes. (auth)

27512 PYL' V ATMOSFERE I OKOLOZEMNOM KOSMICHESKOM PROSTRANSTVE. Trudy Simpoziuma Po Mezhplanetnoi Pyli, Pulkovo, USSR, Dekabr' 1970 g. (Dust in the Atmosphere and the Cosmic Space Around the Earth. Proceedings of the Symposium on Interplanetary Dust, Pulkovo, USSR, December 1970). Divari, N. B. (ed.). Moscow; Izdatel'stvo Nauka (1973). 212p. (CONF-701237-).

Papers are compiled in which the results of studies of the dust in the upper atmosphere and the cosmic space around the Earth are reported. A series of papers deals with questions on the existence of dust clouds around the Earth and the possibility of their detection. Optical methods for probing the upper atmosphere are given and the possibility of investigating the upper atmosphere by twilight methods and by observation methods during the reentry of space vehicles in the Earth's shadow is analyzed. (tr-auth)

27513 ZIRCONIUM AND HAFNIUM IN METEORITES. Ehmann, W. D.; Chyi, L. L. (Univ. of Kentucky, Lexington). Earth Planet. Sci. Lett.; 21: No. 3, 230-234(Feb 1974).

The abundances of zirconium and hafnium have been determined in nine stony meteorites by a new, precise neutron-activation technique. The Zr/Hf abundance ratios for the chondrites vary in a rather narrow range, consistent with previously published observations. Replicate analyses of new, carefully selected clean interior samples of the C1 chondrite Orgueil yield mean zirconium and hafnium abundances of 5.2 and 0.10 ppM, respectively. These abundances are lower than reported earlier for two C1 chondrite samples which may have suffered contamination. The new C1 zirconium and hafnium abundances are in closer agreement with predictions based on theories of nucleosynthesis than the earlier data. (auth)

27514 TRANSITION PROBABILITIES FOR THE 3d10/1S/nl CONFIGURATION OF Cu II AND IDENTIFICATIONS IN THE SOLAR SPECTRUM. Biemont, E. (Liege Univ., Cointe-Ougree, Belg.). Bull. Soc. Roy. Sci. Liege; 42: No. 5-6, 206-217(1973). (In French).

27515 GROWTH CURVE CONSTRUCTED FROM Fe I LINES FOR THE CENTER OF THE SOLAR DISK. Kuli-Zade, D. M.; Guseinov, K. I. (Azerbaydzhan State Univ., Baku). Astron. Vestn.; 7: 167-171(1973). (In Russian).

27516 STATISTICAL RELATIONSHIPS BETWEEN SOLAR WIND AND IONOSPHERE. Burkard, O. M. (Inst. fuer Weltraumforschung, Graz). Z. Geophys.; 39: 739-752(Oct 1973). (In German).

It is shown that there exists a series of statistically significant relationships between the solar-wind velocity and the frozen-in magnetic field on the one hand and the critical frequencies foF and foF2 resp. of the ionospheric F layer on the other hand. Obviously there is at work a coupling mechanism ranging from the ionosphere up the magnetopause to a greater extent than supposed hitherto. Another result of the statistical investigations shows that the particles of the solar wind require 13 days to get from the Sun to the Earth. The starting-point of the solar wind probably lies relatively deep within the Sun, where the velocity is still very small. (auth) (IAA)

27517 VARIATIONS OF THE MAGNETIC FIELDS IN INTERPLANETARY SPACE AND ON THE EARTH'S SURFACE. Fel'dshtein, Ya. I. Vestn. Akad. Nauk SSSR; 15-27(Aug 1973). (In Russian).

The relation between terrestrial magnetic variations and variations in the interplanetary magnetic field of solar origin is considered. In particular, a detailed analysis is made of the relation between the variation in the interplanetary magnetic field and variations of the geomagnetic field in polar regions. Among the topics discussed are field variations in the polar cap in relation to the sector structure of the interplanetary magnetic field, the dominant direction of the interplanetary magnetic field, and the current system induced by the interplanetary magnetic field and responsible for the observed geomagnetic field variations. Also analyses are made of the relation between the interplanetary magnetic field and magnetospheric substorms and of the relation between the interplanetary magnetic field and DP2 type terrestrial variations of the geomagnetic field. (IAA)

27518 SOLAR RADIO BRIGHTNESS DISTRIBUTION FROM OSO IV uv SPECTROHELIOGRAMS. Chiuderi Drago, F.; Poletto, G. (Osservatorio Astrofisico, Acetri, Italy). Soc. Astron. Ital., Mem.; 44: 171-179(1973).

UV heliospectrograms taken on Oct. 25 and Nov. 29, 1967, by the OSO IV satellite were used to derive the brightness distribution in two solar active regions at a wavelength of 9.1 cm, assuming the existence of a relation between N and T in the solar atmosphere. A good agreement was obtained between the optical observations and the Stanford maps. The agreement between uv and radio data was also good when the shape, dimensions, and brightness of some active regions were analyzed in more detail. (IAA)

27519 FIRST RESULTS OF THE SOLAR HARD X-RAY SPECTROMETER ON BOARD THE ESRO TD-1 A SATELLITE. van Beek, H. F.; de Feiter, L. D. (State Univ., Utrecht). pp 777-780 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

The solar hard x-ray spectrometer on board the ESRO TD-1 A satellite aims to measure x rays in the energy range from 25 to 900 keV. The viewing direction of the instrument is along the axis of the satellite which is continuously kept pointed at the sun. The detection system consists essentially of a scintillation counter/solid state detector combination with a sensitive area of 5 sq cm. In order to reduce the effects of omnidirectional background radiation a passive shielding has been applied. The solid state detectors are used for charged particle background rejection, and for accurate in-flight calibration with the help of built-in radioactive sources. The whole energy range is split up into twelve logarithmically spaced channels, whose counting rates are recorded every 1.2 seconds for the four lowest channels and every 4.8 seconds for the other ones. (auth) (IAA)

27520 SOLAR CORONA. Tousey, R. (Hulburt Center for Space Research, Washington, DC). pp 713-730 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

Progress on the solar corona during the past year is reviewed. From OSO 7 the white light corona from 3 to 10 solar radii and the XUV corona in the band 171-630 A have been recorded several times each day by NRL since Oct. 3, 1971; simultaneously Goddard Space Flight Center has recorded spectroheliograms in various lines from 1.8 to 400 A. Transients in the K-corona were observed on two occasions. The High Altitude Observatory K-coronameter and the Culgoora radioheliograph reported coincidence between the sudden enhancement and disappearance of a white light streamer, and type II bursts observed in motion. Streamers in the K + F coronas were followed to 40 solar radii by observation with TV cameras placed on the moon by Surveyors 6 and 7, and by direct photography from Apollo 15. (auth) (IAA)

27521 SOLAR-INTERPLANETARY DISTURBANCES DURING 5-18 JUNE 1969/THE PFP INTERVAL/LASY/. Hakura, Y.; Takenoshita, Y.; Ohshio, M. (Radio Research Labs., Tokyo). pp 763-769 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

Solar-terrestrial disturbances during June 5-18, 1969 (Proton Flare Project retrospective interval IASY) were investigated. A number of solar flares and related sudden ionospheric disturbances (SIDs) occurred as the McMath calcium plage regions 10134 and 10135 were activated during the first half of the interval. An enhanced radio S component and delta configuration in the sunspot magnetic field in the region 10134 around June 5, predicted the possible onset of proton-producing flares. A polar cap disturbance (PCD) of the phase of transpolar VLF waves occurred on June 7-10, in relation to a 5 to 21 MeV proton event monitored by the geostationary satellite ATS 1. The major flare that occurred in the region 10134 at 10 UT on June 5 is the most possible cause of the earth-proton event, because of its outstanding radio, optical, and x-ray features. (auth)

27522 SOURCES OF ACCELERATED ELECTRONS ON THE SUN. Korchak, A. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). pp 731-744 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

Solar flares are the main source of accelerated electrons on the Sun. Electrons are accelerated in the region where the main process of the flare energy output takes place, because their total energy may compose a considerable part of the flare energy. The explosive phase of flares and nonthermal electromagnetic radiation, the quasi-stationary phase and the thermal x-rays, x-ray emission in the region of 10 to 30 keV, and optical radiation in the continuum are discussed. (IAA)

27523 OBSERVATIONS OF THE X-RAY EMISSION OF SOLAR ACTIVE REGIONS ON 28 NOVEMBER 1970 AND

20 AUGUST 1971. Kordylewski, Z.; Mergentaler, J.; Jakimiec, J.; Sylwester, B.; Sylwester, J. (Obserwatorium Astronomiczne, Wroclaw). pp 787-792 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

27524 IMPULSIVE INCREASE IN THE INTENSITY OF SOLAR X-RAYS. Kocharov, G. E.; Charikov, Yu. E. pp 793-796 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

The peculiarities of the solar x-ray burst detected on the moon by the spectrometric arrangement RIFMA are considered. The time characteristics of the burst are obtained: the rise and decay times are 8 and 15 seconds respectively; the total duration is about 60 seconds. The time dependence of the differential energy spectrum of x-rays is obtained. It is shown that the steepness of the differential spectrum decreases with time. (auth)

27525 ENHANCEMENTS OF THE PHOTOELECTRON-EXCITED DAYGLOW DURING SOLAR FLARES. Opal, C. B. (Hulburt Center for Space Research, Washington, DC). pp 797-802 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

Enhancements of about 50% in the 1356-1600 A ultraviolet dayglow were observed by detectors on the OGO 4 satellite during four solar flares in late 1968. This airglow consists mainly of emissions from the Lyman-Birge-Hopfield system of N_2 and is excited in the 160 km region by photoelectrons produced by 60-600 A solar EUV radiation. Simultaneous measurements of the solar EUV spectrum were not available, but it was deduced that increases of as much as 2 erg per sq cm per sec in this wavelength range were responsible for the enhancements. The time history of the enhancements followed the gradual flare component, as observed in soft x-ray emission, rather than the impulsive component observed in microwave emission. (auth)

27526 PARTICLE EMITTING FLARES AND THE LARGE-SCALE DISTRIBUTION OF SOLAR MAGNETIC FIELDS AND GREEN CORONA. Bumba, V. (Ondrejov Observatory, Czech.); Sykora, J. pp 803-808 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

27527 OBJECTIVE BASELINE FOR FLARE PREDICTION. Podsiadlo, R. T. (Cambridge Research Labs., Bedford, MA). pp 817-820 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

The relationship between various measurable solar parameters and solar flare occurrence is examined utilizing a comprehensive solar-geophysical data base containing a variety of objectively correlated solar measurements. The sample covers the period from January 1955 through February 1968 and includes such parameters as solar flares, sunspots, magnetic fields of sunspots, calcium plages, and 9.1 cm radio brightness temperatures. A statistical analysis was performed to determine the parameters most useful for the prediction of solar flares twenty-four hours in advance. Persistence was identified as the single most important flare predictor, with sunspot magnetic classification, 9.1 cm radio brightness temperature, plage brightness and sunspot area also selected as useful predictors. (auth)

27528 DEVELOPMENT OF METHODS OF SOLAR FLARE FORECASTING. Severnyi, A. B.; Steshenko, N. V. (Krymskaya Astrofizicheskaya Observatoriya, Partizanskoye, USSR). pp 809-815 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

The method of solar flare forecasting developed and applied at the Crimean observatory is based on the physical idea of the flare as a strong instability in the magnetic field of the active region, as a rule in the magnetic field of sunspots. The maximum gradient of longitudinal magnetic field near neutral lines dividing three or more spots (magnetic hills) is a quantitative measure of the potential possibility of flare appearance. An attempt is made to find quantitative expressions for the connection with the probability of solar flare appearance of other properties of the active region, such as active region development, size of the group and quantity of sunspots in it, H-alpha plage characteristics, radio-emission peculiarities, and the importance of flares which appear in the region. (auth)

Galaxies

Refer also to abstracts 27477, 27545, and 27722.

27529 GRADIENT INSTABILITIES IN A SYSTEM OF GRAVITATING POINT MASSES. Bisnovatyi-Kogan, G. S.; Mikhailovskii, A. B. (Inst. of Applied Mathematics, Moscow). Sov. Astron. AJ (Engl. Transl.); 17: No. 2, 205-208(1973).

Translated from Astron. Zh.; 50: No. 2, 312-319(1973).

It is shown that there exists a gradient (drift) instability associated with a radial dependence of the longitudinal temperature in a rotating, equilibrium, infinitely long, radially bounded cylinder that is stable in the sense of Jeans. A study is made of the effect of a density inhomogeneity on the stability of such a cylinder. It is shown that when $d\rho/dr \neq 0$, the temperature gradient instability can be stabilized; the boundaries of the stable region are determined. (auth)

27530 DETERMINATION OF ABSOLUTE STELLAR PROPER MOTIONS RELATIVE TO GALAXIES IN SELECTED AREA 32 OF THE SPECIAL KAPTEYN PLAN. Bolbochanu, A. V. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.); 17: No. 2, 234-238(1973).

Translated from Astron. Zh.; 50: No. 2, 362-370(1973).

A total of 143 galaxies have been identified on $2° \times 2°$ first- and second-epoch Pulkovo normal-astrograph plates that include the special Selected Area 32, using Zwicky's galaxy catalog. Of these, 92 reference galaxies appearing on two pairs of plates ($\bar{m}_{pg} = 15.0$ m) were selected and measured. Absolute stellar proper motions were computed directly with respect to the galaxies. The average probable errors in the x, y proper motions of the stars are $\pm 0.0029''$, $0.0027''$; in the "proper motions" of the galaxies, $\pm 0.0072''$, $0.0064''$. A brightness equation is absent in μ_x, but possibly present in μ_y. A comparison with the absolute proper motions of 17 bright stars listed in the AGK 3 indicates an appreciable systematic difference $\Delta\mu_y$ (AGK 3−Pulkovo) $= -0.0069''$. Equations are derived for comparing the reductions of relative to absolute proper motions with respect to galaxies and to reference stars. Statistical absolutization corrections are computed for Binnendijk's and Vasilevskis' secular parallaxes, and the relative μ of the 17 bright stars are compared with the absolute μ given in the AGK 3. These corrections are two or three times smaller for Binnendijk's parallaxes than for three other cases. (auth)

27531 PREDISSOCIATION IN THE $C^2\Sigma^+$ STATE OF CH AND ITS ASTROPHYSICAL IMPLICATIONS. Elander, N.; Smith, W. H. (Princeton Univ., NJ). Astrophys. J.; 184: No. 2, 663-670(1 Sep 1973).

Lifetimes for individual rotational lines of the $C^2\Sigma^+$ state of CH show all levels to be affected by a weak predissociation. This predissociation has the effect of rapidly destroying interstellar CH under the influence of the interstellar radiation field yielding a lifetime against photodissociation of 10^{10} s. This is a factor of 10 less than previously presumed from the direct photodissociative process. The origin of the predissociation is found to be an interaction with the $B^2\Sigma^-$ state continuum levels. (auth)

27532 INFRARED MAPS OF THE GALACTIC NUCLEUS. Rieke, G. H. (Univ. of Arizona, Tucson); Low, F. J. Astrophys. J.; 184: No. 2, 415-425(1 Sep 1973).

The nucleus of the Galaxy has been mapped at 3.5, 5.0, 10.5, and 21 μ with a resolution of 5.5'. At least five discrete sources are resolved from the diffuse background, which in turn is separated into three components. The spectra and luminosities favor thermal models for all sources. (auth)

27533 RELAXATION TIME IN DISK GALAXY SIMULATIONS. Hohl, F. (Langley Research Center, Hampton, VA). Astrophys. J.; 184: No. 2, 353-359(1 Sep 1973).

An initially stationary and stable axisymmetric disk of stars with a mass spectrum of stars is used to determine the collisional relaxation time. The relaxation time as determined from the rate of energy equipartition was found to be 560 rotation periods for stars with 10 times the mean star mass and was 1700 rotation periods for stars with 0.55 times the mean star mass. These times are in general agreement with theoretical predictions for the relaxation time of the two mass groups. The results show that the model used for the large-scale gravitational N-body calculations is indeed "collisionless". (auth)

27534 STATISTICAL APPLICATION OF THE VIRIAL THEOREM TO NEARBY GROUPS OF GALAXIES. Geller, M. J.; Peebles, J. J. E. (Princeton Univ., NJ). Astrophys. J.; 184: No. 2, 329-341(1 Sep 1973).

A statistical method of application of the virial theorem to the small groups of galaxies in the general "field" of nearby galaxies, $m_{pg} \leq 13$, is described. The advantage of this statistical method is that one does not have to decide whether any particular galaxies, is a member of any particular group. The result of the calculation is an indicated mean mass per galaxy of about 2×10^{12} $M_\odot$, in agreement with previous calculations. (auth)

27535 SYNTHESIS OF OUR PRESENT KNOWLEDGE OF INTERSTELLAR DUST. Wesson, P. S. (St. John's Coll., Cambridge, Eng.). Space Sci. Rev.; 15: No. 4, 469-482(Feb 1974).

The present state of knowledge as regards interstellar dust is reviewed in Section 1 (Introduction); Section 2 (Composition of dust grains: graphite, silicate, dirty-ice, diamond); Section 3 (Size of grains: mainly $r \simeq 10^{-6}$ cm); Section 4 (Charge and temperature of grains: charge varies from 1-10 electrons (H I clouds) to 500 electrons (H II clouds); temperature of grain material is about 10-20K); Section 5 (Distribution and origin of grains: confined mainly to discs and arms of spiral galaxies, having had a passive origin by efflux from late-type stars or carbon-stars); Section 6 (Cosmogonical and cosmological aspects of interstellar grains: accretion by electrical-image forces of one dust grain onto a similarly-charged grain links up the absence of dust and gas in elliptical galaxies with the absence of a magnetic field of the type found in spirals. The origin of the 3K background radiation field could be produced by a population of rotating silicate grains of $r \sim 10^{-7}$ cm). (auth)

27536 EXTRATERRESTRIAL UV-BACKGROUND AND THE NEARBY INTERSTELLAR MEDIUM. Fahr, H. J. (Univ., Bonn). Space Sci. Rev.; 15: No. 4, 483-540(Feb 1974).

Recent measurements of the extraterrestrial uv and euv radiation, and the various theoretical approaches used in explaining the measured features of these radiations are reviewed. Whereas the structures and intensities of extraterrestrial euv radiation are essentially undetermined up to now, the observations of the extraterrestrial uv sky give a clear indication of the existence of neutral interstellar hydrogen within the solar system. The effects of solar radiation pressure, and of temporal variations and spatial asymmetries in the solar radiations, on the structure of the extraterrestrial Lα sky are investigated in detail, and the various attempts to derive interstellar parameters from the interpretation of the measured Lα intensities are discussed. From these discussions the local interstellar medium is established as a tenuous hot intercloud H I medium. The amount of its relative motion against the solar system cannot be reliably fixed. Further activities concerning the measurement of extraterrestrial uv and euv radiation features are suggested that may be highly valuable in clarifying the outstanding problems. (auth)

27537 CENTER OF THE GALAXY. Sanders, R. H.; Wrixon, G. T. (67-74; 76-77). Sci. Amer.; 230: No. 4, 67-74; 76-78 (Apr 1974).

Coded in the radio, infrared, and x-ray emissions from the invisible nucleus of the Galaxy is mounting evidence that it is periodically the scene of titanic explosions. (WDM)

27538 RADIUS-PARAMETER AND SURFACE BRIGHTNESS AS A FUNCTION OF GALAXY TOTAL MAGNITUDE FOR CLUSTERS OF GALAXIES. Gudehus, D. H. (Univ. of California, Los Angeles). Astron. J.; 78: No. 7, 583-593(Sep 1973).

Mean relations for the run of radius-parameter and central surface brightness with absolute magnitude are presented for E-SO galaxies in the cores of Abell clusters 754, 1367, and 2065. These data are combined with the adjusted results of Fish (1964) for E galaxies in the Virgo cluster, Holmberg (1969) for nearby E-SO galaxies, and Brookes and Rood (1971) for E galaxies in cluster 1656 to show that the mean relations may differ significantly between clusters. No clear connection with cluster classification is evident. In all clusters, it appears that the fainter galaxies have been tidally distended. The use of the radius-parameter versus magnitude diagram as a relative-distance indicator suggests that redshift is not a good distance indicator for the Virgo cluster, giving a substantial peculiar velocity, and gives support to Abell's cluster fitting method. The central surface brightnesses of first-ranked cluster galaxies exhibit a scatter (m.e.) of about 0.8 mag about the average. These last two results are in disagreement with recent findings by Sandage. (auth)

27539 GALAXY PHOTOMETRY. I. Techniques. Fifft, W. G. (Univ. of Arizona, Tucson). Astron. J.; 78: No. 7, 594-596(Sep 1973).

Techniques for the derivation of nuclear magnitudes in galaxies are summarized. A new method for rapid estimation of nuclear magnitudes by iris photometry is presented and evaluated. It is concluded that with proper calibration, nuclear magnitudes for galaxies in clusters may be estimated with an uncertainty of about ±0.1 mag. (auth)

27540 UBV PHOTOELECTRIC STUDY OF NGC 1300. Burkhead, M. S.; Burgess, R. D. (Indiana Univ., Bloomington). Astron. J.; 78: No. 7, 606-617(Sep 1973).

UBV photoelectric drift scans of the barred spiral galaxy NGC 1300 obtained with the 82-in. reflector at the McDonald Observatory are presented in graphical and tabular form. The observations, obtained with a 15 arcsec diaphragm in an east-west direction along the bar and through the nucleus and in a north-south direction crossing the bar slightly west of the nucleus, illustrate the complex structure of the galaxy and the similarity between the bar and nuclear regions. At a threshold level of $V = 27$ mag/sec^2, the galaxy can be traced to a radius of 250 to 300 arcsec. While the angle of inclination is ambiguous, data are presented which indicate the galaxy may be viewed near face on. The central brightness of the disk component is found to be $B(0) = 21.76$ mag/sec^2 (assuming the galaxy to be observed face on). At an assumed distance of 11 Mpc, the length scale, α^{-1} (kpc), is 3.29. An attempt is made to separate the spiral and disk structure for two crossings of a spiral feature. The colors of the spiral component are not well determined, but are found to be $B-V = +0.4$ and $U-B = -0.3$ at the center of the arm. (auth)

27541 COSMIC GAS DYNAMICS. Part I. Cosmic Gas Dynamics. Part II. Dynamics of Interplanetary Material. Uberoi, M. S. (ed.). New York; John Wiley and Sons, Inc. (1974). 305p. $14.95.

Divided into two parts: cosmic gas dynamics, and dynamics of interplanetary material, the book provides original material on macroscopic transport processes and thermal diffusion as well as complete descriptions of the hydrodynamics of the outer layers of the Sun and stars (including various processes such as flares, electromagnetic coupling, and the heating of the solar corona). Also covered are the theory of interplanetary magnetic fields, transport of rotational momentum, and termination of the solar wind. (WDM)

27542 RADIAL CHANGE OF MEAN FLATTENING OF GALAXIES IN THE COMA CLUSTER. Kalinkov, M. P. Compt. Rend. Acad. Bulg. Sci.; 26: No. 8, 1005-1008(1973).

An analysis of radial flattening characteristics of Coma cluster galaxies on the basis of available data covering some 900 galaxies is given. Formulas are given for the estimation of radial deviations from sphericity in various groups of these galaxies. It is concluded that a completely spherical form of galaxies is more frequent in the center of this cluster with flattening becoming more evident in outer areas of the cluster. (IAA)

27543 CLUSTER OF GALAXIES ABELL 2199. Lohmann, W. (Univ., Heidelberg). Astron. Nachr.; 294: No. 4, 187-189(1973).

Cosmology

Refer also to abstracts 27466, 27469, 28592, 28612, and 28619.

27544 EXACT SOLUTION OF SCHWARZSCHILD PROBLEM IN PAINLEVE COORDINATES. Ganea, I. M. (Bucharest Astronomical Observatory). Stud. Cercet. Astron.; 18: No. 2, 213-215 (1973).

An exact solution is given for the metric of a static spherically symmetric gravitation field in the coordinate system in which the coefficient of c^2dt^2 and the coefficient of transversal element are equal. In this metric the radial coordinate has a minimum value permitted at $3\sqrt{3}m$, which corresponds to the radius of the photon's circular orbit around the central mass. (auth)

27545 GRAVITATIONAL INSTABILITY IN A STATIC UNIVERSE AND THE ANGULAR MOMENTUM OF GALAXIES. Simon, R. (Univ., Liege). Acad. Roy. Belg., Cl. Sci., Mem., Collect. 8; 59: No. 8, 735-749(1973).

Gravitational instability arising from thermal fluctuations in a static Universe is considered in an extrapolation of a weakly nonlinear approximation, to calculate the mean square angular momentum of protogalaxies at the critical time at which these protogalaxies detach themselves from the primeval homogeneous medium. The mean angular momentum of a given volume, containing in the mean a mass M, and the mean angular momentum of a given mass M, are shown to be quite different. It is suggested that it is the latter which should be compared with the observed angular momentum of galaxies. A numerical application shows that such a picture cannot account for the observed angular momentum of the Galaxy and at the same time for the existence of dwarf galaxies. A simple calculation suggests however that tidal interactions arising between neighboring protogalaxies after the critical time of detachment would easily account for the observed angular momentum of spiral galaxies, if these interactions take place before the Universe is set in a state of fully developed expansion. (auth)

27546 ELECTROMAGNETIC WAVES IN AN EXPANDING UNIVERSE. Mashhoon, B. (Department of Physics, Arya-Mehr

University, Tehran, Iran). Phys. Rev. D 8: No. 12, 4297-4302 (15 Dec 1973).

The electromagnetic perturbation equations are solved in a closed Robertson–Walker space-time; the frequency spectrum and the proper modes are found. A simple quantum theory of electromagnetic waves in the background metric is then developed using the proper modes of the static metric conformally connected with the closed Robertson–Walker metric. It is shown that the number of "photons" does not change as a result of expansion (or contraction). The application of these results to the cosmic background radiation is discussed. (auth)

27547 EFFECTIVE HOMOGENEITY OF SOME INHOMOGENEOUS COSMOLOGIES. Lund, F. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 8: No. 12, 4229-4230 (15 Dec 1973).

The Hamiltonian methods used to quantize spherically symmetric, dust-filled systems in general relativity are applied to the locally rotationally symmetric inhomogeneous generalizations of Kantowski–Sachs and Bianchi type-I models. As in the case of spherical symmetry, the ∞ degrees of freedom decouple. Moreover, both systems behave as if they were effectively homogeneous since inhomogeneities are "homogeneously propagated." (auth)

27548 BIG-BANG MODEL WITHOUT SINGULARITIES. Murphy, G.L. (Department of Physics, Westminister College, New Wilmington, Pennsylvania 16142). Phys. Rev. D 8: No. 12, 4231-4233 (15 Dec 1973).

A uniform cosmological model filled with fluid which possesses pressure and second viscosity is developed. The Einstein equations can be integrated exactly. One solution is the steady-state cosmology, but this is unstable. Other solutions start from the steady-state one in the infinite past but expand more and more slowly as viscosity dies out. At any finite proper time in the past the curvature is finite. Some comments on possible origins of this viscosity are given. (auth)

27549 DUST BALL IN EMPTY SPACE. Korkina, M. P.; Martynenko, V. G. (Dnepropetrovsk State Univ., USSR). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 12, 1948-1954(Dec 1973). (In Russian).

A dust ball in empty space is considered, using synchronous coordinates. The conditions are considered for appearance of a semiclosed world in the obtained solution. A visual representation for formation and development of the semiclosed world is given by representing the synchronous system of coordinates as a surface of revolution. The fitting of Friedman's world with the T-solution in the empty space is considered. The R- and T-domains and surface of revolution representing the space part of the obtained world are considered. (auth)

27550 COSMIC ROTATION AND MACH'S PRINCIPLE IN THREE SPECIAL COSMOLOGICAL MODELS. Gomide, F. M. (Instituto Tecnologico de Aeronautica, Sao Jose dos Campos, Brazil). Rev. Brasil. Fis.; 3: 3-16(May 1973).

A critical analysis is developed of the role played by Mach's principle in the formulation of the general theory of relativity. It is suggested that Whitrow's relation for closed spaces represents mathematically the principle considered. Linearized solutions of the field equations as regards cosmic rotation are analyzed for the three possible static cosmological models in order to test the possibility of Mach's principle. The non-empty deSitter and Einstein models satisfy the two fundamental requirements of Mach's principle, whereas the asymptotic Euclidian models do not. (auth)

27551 SOME NEW SOLUTIONS OF THE EINSTEIN EQUATIONS OF ASTROPHYSICAL INTEREST. Demianski, M. (Univ., Warsaw). Acta Astron.; 23: No. 3, 197-232(1973).

A class of solutions to Einstein's field equations, which describe the gravitational field of a bounded distribution of matter, are studied together with cosmological solutions describing the large-scale structure of the Universe. It is shown how a cosmological constant changes the properties of a black hole. The spherically symmetric gravitational collapse of a rotating radiating object that experiences mass losses due to shock waves is examined, and black holes in asymptotically flat spaces and in de Sitter spaces are discussed. A homogeneous cosmological model with rotating matter is developed. It is shown how rotation of matter affects the behavior of a homogeneous cosmological solution near a singularity. The problem of the structure of singularities is analyzed. (IAA)

27552 ESTIMATION OF THE SIZE OF THE UNIVERSE FROM A TOPOLOGICAL VIEWPOINT. Sokolov, D. D.; Shvartsman, V. F. Zh. Eksp. Teor. Fiz.; 66: No. 2, 412-420(Feb 1974). (In Russian).

An analysis of the observational data shows that the data are consistent with the hypothesis that the space of the Universe is a topologically closed structure of small size (irrespective of the curvature sign) which is "glued together". A lower limit on the modern size of the Universe is obtained. The maximal and minimal "gluing parameters" of the world are not less than 400 and 10 Mps respectively. Thus it is possible that the maximal diameter of the Universe is 10 times smaller than the distances to distant quasars usually assumed. If the true gluing parameters are really of the magnitude mentioned above then some of the sources with a redshift $z > 0.0025$ and all sources with $z > 0.1$ are "ghosts" of long extinct and also of existing objects which are close to us. Several dozens of ghosts may correspond to a single object on the celestial sphere. (auth)

Planetary Phenomena

27553 (AD-767050-8-GA) JUPITER'S RADIATION BELTS. Stansberry, K. G.; White, R. S. (California Univ., Riverside (USA)). Jun 1973. Contract N00014-69-A-0200-5001. 58p. (IGPP-UCR-73-23). NTIS $3.50.

Fluxes of electrons and protons in Jupiter's radiation belts are calculated with the source, radial diffusion inward from the solar wind, and the loss, synchrotron radiation. The calculations are tested against the measured radiowave wavelength distribution, the radiowave distribution with distance from Jupiter and the degree of polarization of the radiowaves. The Fokker–Planck equation is solved using the method of Farley and Walt with the flux fixed at the outer boundary and zero flux at Jupiter's surface. It was found in agreement with Brice and McDonough, Jacques and Davis, and Birmingham et al. that the usual magnetic and electric diffusions, that vary as L^{10} and L^{6}, respectively, are insufficient to furnish the required electrons and that the diffusion driven by ionospheric winds of Brice and McDonough is strong enough to furnish Jupiter's belts. (GRA)

27554 CHEMICAL COMPOSITION OF REGOLITH RETURNED BY LUNA-20 FROM THE CONTINENTAL REGION OF THE MOON. Surkov, Yu. A.; Kolesov, G. M.; Kirnozov, F. F. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 1, 3-9(Jan 1974). (In Russian).

The content of some rock-forming rare and rare-earth elements in regolith returned by the automatic station "Luna-20" from the continental region of the Moon was determined by the method of neutron activation. A comparison with similar analyses of regolith returned by "Luna-16" from the region of maria and with literary data on the chemical composition of lunar soil returned by the "Apollos" was carried out. Regolith from maria and continental regions of the Moon differs both in abundance and in the ratio of the separate macro- and micro-elements and reflects by this a qualitatively different character of the geological provinces of the Moon—the maria and the continental areas—which are predominantly composed of basalts and anorthosites. (auth)

27555 STUDIES OF K–Ar DATING AND XENON FROM EXTINCT RADIOACTIVITIES IN BRECCIA 14318; IMPLICATIONS FOR EARLY LUNAR HISTORY. Reynolds, J. H.; Alexander, E. C.; Davis, P. K.; Srinivasan, B. (Univ. of California, Berkeley). Geochim. Cosmochim. Acta; 38: No. 3, 401-417(Mar 1974).

The rare gases argon and xenon were studied intensively in lunar breccia 14318, one of a family of three Apollo 14 breccias exhibiting similarities, including substantial amounts of "parentless" xenon from the spontaneous fission of extinct ^{244}Pu. Stepwise heatings were made on both unirradiated and pile-irradiated specimens. The isotopic composition of the xenon from fission was determined by a new method which invokes a minimum of assumptions; it is shown to be from ^{244}Pu and almost certainly parentless. For example, the fission component, although not appreciably fractionated with respect to the trapped component during stepwise heating, has a low temperature character so that, relatively speaking, it appears to be more superficial than xenon emanating from uranium sites in the irradiated sample. It is demonstrated that this effect is not an artifact of the neutron irradiation. The breccia contains abundant trapped argon with a high ^{40}Ar/^{36}Ar ratio for lunar material = ~14. Otherwise the argon is radiogenic and gives a convincing K–Ar age of 3.69 ± 0.09 b.y. by the stepwise ^{40}Ar–^{39}Ar method, nearly in agreement with ages for other Apollo 14 breccias obtained in the authors' laboratory and elsewhere. Rock 14301, another of the family of breccias and one which has been studied in other laboratories, contains similar trapped argon and parentless xenon. Unlike 14318 it also contains a conspicuous excess of ^{129}Xe from the radioactive decay of extinct ^{129}I. Implications of the parentless xenon from extinct sources, as seen in these different rocks, depend upon the model adopted for its evolution and storage. Four different models are presented, all of which are unsatisfactory in some respects, so that it is at present not possible to narrow the question. It must be stressed that other Apollo 14 breccias, such as 14321, contain fission xenon from ^{244}Pu which was apparently produced in situ. (auth)

27556 THERMAL CHARACTERISTICS OF THE MOON. Lucas, J. W. (ed.). Progress in Astronautics and Aeronautics. Volume 28. Cambridge, MA; Massachusetts Institute of Technology (1972). 351p. $15.00.

The papers included in this volume are grouped into four sections, covering measurements made from Earth, measurements made on the Moon, studies of material brought to Earth from the Moon, and an overall historical survey of the Moon's interior from a thermal standpoint. (WDM)

27557 JUPITER'S IONOSPHERE: PROSPECTS FOR PIONEER 10. Atreya, S. K. (Univ. of Pittsburgh); Donahue, T. M.; McElroy, M. B. Science; 184: No. 4133, 154-156(12 Apr 1974).

Model Jovian ionospheres are constructed for comparison with Pioneer 10 results. Electron density maxima are predicted at a level approximately 220 kilometers above an assumed reference height where the hydrogen density is 10^{16} molecules per cubic centimeter. It may be possible to use observations of the electron density to locate the turbopause. Attention is drawn to a possible strong source of ionized sodium from Io which might lead to large electron densities at low altitudes. (auth)

27558 ELECTRIC POTENTIAL OF THE MOON IN THE SOLAR WIND. Freeman, J. W. Jr.; Fenner, M. A.; Hills, H. K. (Rice University, Houston, TX). J. Geophys. Res.; 78: No. 22, 4560-4567(1 Aug 1973).

Acceleration and detection of the lunar thermal ionosphere in the presence of the lunar electric field yields a value of at least +10 volts for the lunar electric potential for solar zenith angles between approximately 20 and 45° and in the magnetosheath or solar wind. An enhanced positive ion flux is observed with the Apollo Lunar Surface Experiments Package Suprathermal Ion Detector Experiment when a preacceleration voltage attains certain values. This enhancement is greater when the Moon is in the solar wind as opposed to the magnetosheath. (auth)

27559 LOW FREQUENCY GYRO-SYNCHROTRON RADIO NOISE FROM THE EARTH'S OUTER RADIATION BELT. Frankel, M. S. Stanford, CA; Stanford Univ. (1973). 169p. University Microfilms Order No. 73-30,398.

Thesis (Ph. D.).

Electrons spiraling along magnetic field lines emit electromagnetic radiation at radio wavelengths via the cyclotron and synchrotron emission processes. Consequently, with the discovery of the Van Allen radiation belts, the possibility of detecting synchrotron radiation from superthermal electrons trapped in these regions has become an important topic of research. Studies, which to the present have been limited to frequencies above 2 MHz, show that the radio noise from these electrons is not easily detected as it is less than the noise generated by galactic and extragalactic sources. In this study, the problem of detecting cyclotron and synchrotron noise from these superthermal electrons is analyzed for the frequency range 30 kHz to 300 kHz. Due to the earth's ionosphere, ground based observation of this noise is improbable. Therefore, the calculations are made for an observer in the interplanetary medium. In particular, the location is chosen in the geomagnetic equatorial plane at a geocentric distance of 32 earth radii. This position of the observer allows the theoretical results to be compared directly with data obtained from the Goddard Space Flight Center (GSFC) radio astronomy experiment aboard the IMP-6 spacecraft. (Diss. Abstr. Int., B)

27560 RADIOHALOS IN A RADIOCHRONOLOGICAL AND COSMOLOGICAL PERSPECTIVE. Gentry, R. V. (Oak Ridge National Lab., TN). Science; 184: No. 4132, 62-66(5 Apr 1974).

New photographic evidence, data on halo ring sizes, and x-ray fluorescence analyses provide unambiguous evidence that polonium halos exist as a separate and distinct class apart from uranium halos. Because of the short half-lives of the polonium isotopes involved, it is not clear how polonium halos may be explained on the basis of currently accepted cosmological models of Earth formation. (auth)

27561 SURFACE AND ORBITAL MAGNETIC RESULTS FROM APOLLO 15. Russell, C. T.; Coleman, P. J. Jr.; Lichtenstein, B. R.; Shchubert, G.; Sharp, L. R. (Univ. of California, Los Angeles). pp 951-960 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

Orbital and surface measurements reveal that magnetization is a general property of the lunar surface, but show no evidence for a presently existing planetary magnetic field similar to that of the earth. The surface magnetic field is irregular with a scale size of the order of 10 km and weak in comparison with that at the surface of the earth. Fields of up to 300 gammas have been measured on the surface of the moon. Orbital data show the field is stronger and more irregular on the far side than on the near side of the moon. When the moon is in the solar wind, a plasma void occurs behind the moon, due to the absorption of the solar wind by the surface of the moon. The field strength in the plasma void is larger than that in the solar wind owing to diamagnetism. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 27516.

27562 INVESTIGATION OF GEOACTIVE CORPUSCLES AND PHOTOELECTRONS WITH THE KOSMOS 261 SATELLITE. VI. Superthermal Electrons at Energies 30 to 150 eV in the Day- and Nightside Polar Cusps. Shuiskaya, F. K. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 4, 512-517(1973).

Translated from Kosm. Issled.; 11: No. 4, 574-580(1973).

A discussion is given of measurements of the differential electron flux in the energy range 30 to 150 eV at heights of 200 to 650 km in the polar zones, as recorded at various local times with the Kosmos 348 and Kosmos 261 satellites. A substantial flux of superthermal electrons (10^5 to 10^6 electrons $\cdot$ cm^{-2} sec^{-1} $\cdot$ sr^{-1} $\cdot$ eV^{-1}) was always observed at ionospheric heights during periods of quiet or moderate magnetic activity for invariant latitudes above 70° on the day side and above 65° on the night side. The distribution of the electron flux along the Earth appears to be continuous from noon to 5 h on the morning side and from noon to 20 h on the evening side. Soft-electron streams were observed immediately beyond the boundary of the closed magnetic-field lines, if the boundary is taken at the point of sharp decline in the intensity of high-energy electrons (tens of keV). At energies E = 30 to 150 eV the electron energy spectrum exhibits two characteristic maxima, one at E ≈ 60 eV and the other for E ≈ 120 to 130 eV. (auth)

27563 IONOSPHERE TOTAL ELECTRON CONTENT AND ITS HORIZONTAL GRADIENTS, MEASURED ON THE BASIS OF SATELLITE SIGNAL RECORDINGS AT SCATTERED POINTS. Misyura, V. A.; Podnos, V. A.; Kapanin, L. L; Tsymbal, A. M.; Mokryi, V. M.; Zagvozdkin, B. V. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 4, 518-521(1973).

Translated from Kosm. Issled.; 11: No. 4, 581-585(1973).

The integrated electron content of the ionosphere up to the level of the recording satellite, and the horizontal gradients of the integrated electron content (total, latitudinal, and longitudinal components), was obtained at scattered observation points located at medium and high latitudes, on the basis of recordings made of Doppler and Faraday effects on coherent signals from the satellites Explorer-22, Explorer-27, Interkosmos-2, Kosmos-321, Kosmos-356, and Kosmos-381. (auth)

27564 OPTIMUM NUMBER OF SOUNDINGS FOR A COMPLETE INVESTIGATION OF THE IONIZATION-NEUTRALIZATION AND DYNAMIC CHARACTERISTICS OF THE MIDDLE IONOSPHERE. Serafimov, K. B. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 4, 522-529(1973).

Translated from Kosm. Issled.; 11: No. 4, 586-594(1973).

The measured variables and minimum number of rocket soundings required for a complete investigation of ionization-neutralization, charge-exchange, and dynamical processes at work in the middle ionosphere, as part of a program including land-based and satellite patrol measurements, are determined. Combined measurements from the Earth's surface and satellite data on solar ionizing radiation make it possible, in some instances, to calculate the specific recombination and charge-exchange characteristics, components of electron transport, and variations in the electron production rate, with the aid of three rocket soundings over a 24-h period. Changes in the temperature in the ionized and neutral composition of the atmosphere, and variations in the effective recombination coefficient are also determined. Formulas are derived to aid finding the optimum number of rocket soundings in the general case, and appropriate time periods for carrying out the soundings are recommended. (auth)

27565 AURORAL OVAL IN REGION OF ELECTRON PRECIPITATION INTO EARTH'S ATMOSPHERE. Fel'dshtein, Ya. I. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 4, 566-568(1973).

Translated from Kosm. Issled.; 11: No. 4, 632-634(1973).

Frank, et. al. (1971, 1972) gave the first results of observations of the fluxes of electrons and protons in the energy range 50 eV ≤ E ≤ 50 keV precipitating into the upper atmosphere in high latitudes. The observations made by Injun 5 in circumpolar orbit are discussed. (WDM)

27566 OCCURRENCE OF RADIO AURORA AT HIGH LATITUDES: THE IGY PERIOD, 1957–1959. McNamara, A. G. (National Research Council of Canada, Ottawa). pp 135-149 of Collection of Articles on Cosmic Geophysics. Holtet, J. (ed.). Oslo; Universitetsforlaget (1972).

Two years of data resulting from the operation of an auroral radar network in the Canadian Arctic have been analyzed to determine the factors controlling the occurrence of radio aurora. The radars were located at Ottawa, Saskatoon, Baker Lake, and Resolute, at magnetic latitudes of 58.9, 61.5, 75.1, and 84.3°N. It was found that magnetic aspect control is not very strong at 48.5 MHz, and that echoes were obtained at all azimuth angles even where the aspect was 19° away from perpendicularity. The latitude of most frequent echo occurrence coincided with maximum of the visual aurora zone. Midnight maxima were observed in the diurnal occurrences at Ottawa, Saskatoon, and Baker Lake, but the maximum occurrence at Resolute was near local noon. (auth)

27567 AURORAL PARTICLES. Hultqvist, B. (Kungliga Vetenskapsakademien, Kiruna, Sweden). pp 27-55 of Collection of Articles on Cosmic Geophysics. Holtet, J. (ed.). Oslo; Universitetsforlaget (1972).

Auroral particles are defined as suprathermal particle populations with energies of less than 100 eV to a few hundred keV, some of which are precipitated into the atmosphere causing atmospheric excitation and ionization. The distribution of such particles in the magnetosphere, their average characteristics, dynamics, and morphology are discussed in some detail. The behaviour of substorms is described. The energy spectra of auroral electrons and protons are presented and discussed, followed by the pitch-angle distribution. Finally some of the processes by which solar-wind particles are believed to be accelerated to auroral particle energies and precipitated into the atmosphere are briefly described. (NO)

27568 AURORA. Feldstein, Ya. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-wave Propagation, Moscow). pp 57-72 of Collection of Articles on Cosmic Geophysics. Holtet, J. (ed.). Oslo; Universitetsforlaget (1972).

A review of recent investigations on auroral space–time regularities and their relation to electron fluxes responsible for the auroral luminescence is given. The position of precipitation regions together with the auroral oval is presented. A connection between the auroral oval and the large-scale structure of the magnetosphere is discussed as are variations of inner magnetosphere dimensions and magnetic fluxes responsible for magnetic-tail formation at different phases of the magnetic substorm. A general scheme of auroral substorm development in the northern high-latitude region, consisting of three phases, i.e., the creation, expansion, and recovery phase, is illustrated. On the basis of auroral data, the average energy flux of precipitating electrons in different sectors of the auroral oval, as well as the relation of aurora with the region of transverse magnetic disturbances is obtained. (auth)

27569 MIDDAY AURORAS AND POLAR CAP AURORAS. Akasofu, S. I. (Univ. of Alaska, College). pp 73-85 of Collection of Articles on Cosmic Geophysics. Holtet, J. (ed.). Oslo; Universitetsforlaget (1972).

Characteristics of midday auroras (which occupy the noon sector of the auroral oval) and polar-cap auroras (which appear inside the area surrounded by the auroral oval) are described by reviewing earlier studies and also new satellite and airborne all-sky data. The relationships between the midday auroras and polar-cap auroras are also discussed. There is little doubt that behavior of the midday and polar-cap auroras will give many clues on the interactions between the solar wind and the geomagnetic field. (auth)

27570 CLASSIFICATION OF HIGH-LATITUDE AURORAS. Lassen, K. (Danish Meteorological Inst., Charlottenlund). pp 87-104 of Collection of Articles on Cosmic Geophysics. Holtet, J. (ed.). Oslo; Universitetsforlaget (1972).

Polar graphs showing the distribution of mean auroral frequencies as observed from the network of all-sky cameras in Greenland are presented for values of Kp from 0 to 5. The grouping of the frequencies in the plots and the dependence of this on Kp as well as on the sunspot activity is discussed. Details are presented from single nights, and finally, with support from a survey of the position in the polar graph of observed arcs and bands at Kp = 1, the following model of the auroral grouping is inferred; the main precipitation curve is a spiral-like figure, situated in the morning at 75°–80° between 0300 corrected geomagnetic time and the noon sector. From this it decreases monotonically in latitude through the afternoon and evening

hours down to 65° to 70° at 0200. This precipitation is mixed up with a night-system between 70° and 75° in the midnight sector, as well as with a system of polar-cap arcs converging from the whole night sector at 70° to 80° towards the cusp region in the noon sector. The model presented here implies a discontinuity in the main precipitation curve in the early morning; it is valid for quiet magnetic conditions. (auth)

27571 ELECTRON-DENSITY INCREASE IN THE E LAYER BELOW AN ARTIFICIAL BARIUM CLOUD. Stoffgren, W. (Foersvarets Forskningsanstalt, Uppsala). pp 151-156 of Collection of Articles on Cosmic Geophysics. Holtet, J. (ed.). Oslo; Universitetsforlaget (1972).

During the first two minutes after the release of an artificial barium cloud at a height of 187 km, a local enhancement of the electron density in the E layer geomagnetically below the cloud was observed. This observation was made by using a vertical ionospheric sounder tuned to 2.5 MHz. A similar effect had previously been studied indirectly by means of spectral observations at 5577 Å and 4278 Å. An increased emission was observed when the instrument was pointed towards the area below the cloud in the E layer. (auth)

27572 HARANG DISCONTINUITY IN AURORAL BELT IONOSPHERIC CURRENTS. Heppner, J. P. (National Aeronautics and Space Administration, Greenbelt, MD). pp 105-120 of Collection of Articles on Cosmic Geophysics. Holtet, J. (ed.). Oslo; Universitetsforlaget (1972).

Attention is directed to Harang's contribution in recognising and emphasising the midnight discontinuity in the auroral zone. The reversal of E–W currents later demonstrated confirmed his expectations, and the author names the effect the "Harang discontinuity". It is then shown that the discontinuity in fact occurs between 2200 and 2300 MLT. A similar, but less striking discontinuity occurs near 1000 MLT on the dayside, but not being emphasized by Harang is not deemed to be a "Harang discontinuity". Auroral discontinuity is then discussed and found to correspond with the Harang discontinuity. The question of a convective model of high-latitude disturbances is discussed with reference to barium release experiments and its relation to the Harang discontinuity. The time variability of the Harang discontinuity is generally confined to less than 2 hours of MLT while major sudden shifts as large as 3 hours in MLT must be rare. A diagram drawn by Harang in 1946 of in-flow and out-flow of currents from the centre of the auroral belt currents is dominated by the out-flow of current on the nightside, centered on the discontinuity. This supports geometrically the conclusions reached by Heppner et al. in a paper in 1971. In conclusion a number of related topics which could fruitfully be studied in this context are mentioned. (NO)

27573 FORMATION OF THE IONOSPHERE IDEAS OF THE EARLY YEARS (1925-1955). Ratcliffe, J. A. pp 13-26 of Collection of Articles on Cosmic Geophysics. Holtet, J. (ed.). Oslo; Universitetsforlaget (1972).

A historical survey of the development of theoretical and experimental investigations of the ionosphere from 1925 to 1955, with emphasis on the work of Harang, is given. Early radio investigations are described and the discussion of whether photons or corpuscular radiation were the cause of ionization is treated. The constitution of the atmosphere and the heights of the layers and the rate of loss of electrons are also subjects of discussion. Finally an extensive bibliography is given. (NO)

27574 DRIFT-DISSIPATIVE PLASMA INSTABILITIES GENERATED BY NEUTRAL VELOCITY DISTURBANCES IN IONOSPHERE. Klos, Z. (Inst. of Physics, Warsaw). Acta Geophys. Pol.; 21: No. 4, 277-292(1973).

This paper is an analysis of the drift-dissipative instability generated by neutral velocity disturbances in the weakly ionized ionospheric plasma. Starting from the equations of two-component model of weakly ionized, anisotropic and quasi-neutral plasma, with gradient of the electron concentration, and ambient electric field, the expression for the time dependence of the ionization perturbation at given disturbance in neutral wind velocity is obtained. The calculations are done in linear approximation. The full expression of the growth rate is given as well as the necessary condition for possible directions of unstable mode propagations. Numerical calculations are presented for some parameters of ionospheric plasma in the bottom ionosphere. (auth)

27575 INFLUENCE OF THE IONOSPHERIC MODEL OF THE INTEGRATED ELECTRON CONTENT DETERMINATION. Domoslawski, W. (Inst. of Geophysics, Warsaw). Acta Geophys. Pol.; 21: No. 4, 293-303(1973).

The differences resulting from the use of various models of the electron concentration in the ionosphere for calculation of the mean value of coefficient $\bar{M}$ in the Faraday effect are considered. The Chapman and Nisbet models are taken into account. The second-order effects resulting from the high-frequency approximation, refraction and birefringence are estimated. Based on three recordings of the Faraday effect of the Explorer-22 signals, obtained for various positions of the satellite on its path, the differences in second-order effects in coefficient $\bar{M}$, resulting from the use of the Chapman and Nisbet models, are discussed. (auth)

27576 ELECTRIC FIELD VARIATIONS IN A MEDIUM WITH VARIABLE CONDUCTIVITY, PRODUCED BY A POINT CHARGE ABOVE A CONDUCTIVE PLANE. Michnowski, S. (Inst. of Geophysics, Warsaw). Acta Geophys. Pol.; 21: No. 4, 305-324(1973).

The transient time variations of electric field in inhomogenous medium were examined theoretically. The general equations and their simplified solutions were derived for the case of a suddenly discharged pole embedded in a medium with exponentially variable conductivity. The pole was treated as a point charge situated above a highly conductive plane. The results obtained differ from those calculated by Tamura and by Kasemir in spite of similar physical models used. This difference is caused mainly by new initial conditions adopted in the present analysis. For large distances from the place of observation to the discharged pole and for small values of time, the obtained simplified solution of general equations makes it possible to show analytically a decrease of recovery time of field variation with the growing distance, and to ascribe the behavior of these variations to the effect of space charge formed in the medium. The decrease of recovery time in the range of great distances was observed experimentally and could not be explained analytically by any previous theory. (auth)

27577 WHISTLER-MODE HISS AT LOW AND MEDIUM FREQUENCIES IN THE DAYSIDE-CUSP IONOSPHERE. James, H. G. (Communications Research Centre, Ottawa). J. Geophys. Res.; 78: No. 22, 4578-4599(1 Aug 1973).

Simultaneous measurements from the Isis 1 satellite of soft-electron fluxes and of auroral hiss at low and medium frequencies indicate that such noise emissions can propagate to the north or south of the L shell containing the precipitating electrons through distances up to 1000 km or about 3° invariant latitude at 2000 km altitude. This latitudinal spreading suggests that the noise propagation corresponds to those parts of the whistler-mode dispersion curves where the waves are electric, that is, near the resonance cone. The relative variations of the LF and MF spectra can be roughly accounted for by a simple ray-tracing technique assuming electric waves. Ionograms recorded at the same time as the noise measurements were reduced to real height profiles of electron density, thus giving a two-dimensional ambient electron distribution for ray tracing. Absolute intensities of noise were computed by using observed electron flux densities and assuming an incoherent Cerenkov mechanism. The theoretical power levels are at least two orders of magnitude lower than those observed. It is concluded that the incoherent theory for the wave generation mechanism is inapplicable, assuming that the antenna impedance theory that was used is suitable. (auth)

27578 WAVE GUIDE PROPAGATION OF MICROPULSATIONS OUT OF THE PLANE OF THE GEOMAGNETIC MERIDIAN. Greifinger, C.; Greifinger, P. (R and D Associates, Santa Monica, CA). J. Geophys. Res.; 78: No. 22, 4611-4618(1 Aug 1973).

A numerical solution is obtained for the coupled differential equations governing the propagation of Pc 1 micropulsations in the ionospheric wave guide in directions out of the plane of the geomagnetic meridian. A significant difference from previously obtained in-meridian results is the appearance of resonant absorption peaks at certain frequencies. The resonances arise from coupling between the "ducted" mode and the "field-guided" mode, which removes energy from the wave guide. The resonant frequencies depend on ionospheric parameters and dip angle, but not on the direction of propagation. The amplitude of the resonances, however, increases with deviation from the geomagnetic meridian. The existence of geographically dependent frequency passbands implied by these results makes it questionable that micropulsations can propagate without appreciable attenuation in directions other than geomagnetic N–S or possibly geomagnetic E–W. (auth)

27579 WHISTLER-INDUCED AMPLITUDE PERTURBATION IN VLF PROPAGATION. Helliwell, R. A.; Katsufrakis, J. P.; Trimpi, M. L. (Stanford Univ., CA). J. Geophys. Res.; 78: No. 22, 4679-4688(1 Aug 1973).

Sudden changes in the amplitude of long-distance subionospheric VLF transmissions were found at night in association with whistlers. Both increases and decreases in signal strength were observed, depending on signal frequency and orientation of the receiving antenna. Sample observations at Eights Station in Antarctica of station NSS (Annapolis, Maryland) on 22.3 kHz showed increases

in signal strength that averaged 3 db, with rise times of about 2 sec and durations of about 30 sec. Coincident with every rise was a midlatitude (L ≈ 2.5) whistler originating in the northern hemisphere. To explain this association, it is suggested that the whistler dumps energetic (30-300 keV) electrons into the D region. The resulting ionization then alters the properties of the earth-ionosphere wave guide. The mechanism of precipitation is thought to be pitch angle scattering of trapped electrons that resonate with the magnetic field of the whistler wave near the magnetic equator. (auth)

27580 SOME RESULTS OF INVESTIGATIONS OF NONLINEAR PHENOMENA IN THE F-LAYER OF THE IONOSPHERE. Getmantsev, G. G.; Komrakov, G. P.; Korobkov, Yu. S.; Mironenko, L. F.; Mityakov, N. O.; Rapoport, V. P.; Trakhtengerts, V. Yu.; Frolov, V. L.; Cherepovitskii, V. A. (Radiophysics Research Inst., Gorky, USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 10, 364-366(20 Nov 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 10, 621-624(20 Nov 1973).

Results of experiments on the nonlinear action of powerful radio waves on the F-layer of the ionosphere are reported and discussed. (auth)

27581 CRITICAL APPRAISAL OF THE METHOD OF ESTIMATING EQUATORIAL ELECTROJET STRENGTH. Kane, R. P. (Physical Research Lab., Ahmedabad, India). Proc. Indian Acad. Sci., Sect. A; 78: No. 4, 149-158(Oct 1973).

The merits and demerits of the usage of Sd_1, the ionospheric component of the electrojet strength, as the whole electrojet strength are examined. (MHR)

27582 REVIEW OF AURORAL MORPHOLOGY, AURORAL DYNAMICS, AND MODERN OBSERVATIONAL TECHNIQUES. Romick, G. J. (Univ. of Alaska, Fairbanks). Radio Sci.; 9: No. 2, 323-334(Feb 1974).

The present understanding of auroral morphology has been developed in a large part from a vast accumulation of all-sky camera photographs taken at many stations around the world. In order to further our understanding of the concepts of the auroral oval and the auroral substorm and their relation to influences on our atmosphere, one needs to express these concepts in terms of the latitudinal distribution of the type and energy of the associated incident particles. In this review, data are presented on precipitating particles in the evening and midnight sectors in relationship to the electron trapping boundary motion within the substorm. The complex height distribution of ionization associated with particle precipitation shows some of the possible complexities in the interpretation of incoherent scatter radar data obtained in the auroral regions. Data obtained by modern satellite imagery can provide the auxiliary data needed to understand the particle effects in the polar regions. The rapid temporal and spatial changes in the aurora are seen in data from rapid scanning photometer systems and high sensitivity color television systems. The general review of these data attempts to show that local auroral dynamics and the phase and global extent of the auroral substorm imply drastic changes in the incident particle energies. These in turn produce variable atmospheric effects of direct concern to all incoherent scatter radar studies of the neutral and ion composition, temperature, and motion of the earth's atmosphere. (auth)

27583 SIMULTANEOUS RIOMETER AND INCOHERENT SCATTER RADAR OBSERVATIONS OF THE AURORAL D REGION. Hunsucker, R. D. (Univ. of Alaska, College). Radio Sci.; 9: No. 2, 335-340(Feb 1974).

Some incoherent scatter radar observations of high latitude D-region ionization profiles during auroral disturbances and during the great magnetic storm of August 1972 are presented. Simultaneous 30-MHz riometer and magnetometer data from the College, Alaska area and IMP-5 and -6 satellite data are utilized to interpret the ionization profiles. (auth)

27584 ELECTRON DENSITIES WITHIN AURORAE AND OTHER AURORAL E-REGION CHARACTERISTICS. Baron, M. J. (Stanford Research Inst., Menlo Park, CA). Radio Sci.; 9: No. 2, 341-348(Feb 1974).

The L-band incoherent scatter radar located at Chatanika, Alaska (L ≈ 5.6) has been used to measure the characteristics of the auroral E layer. In this paper, the term auroral E layer refers to nighttime ionization between altitudes of 90 to 150 km produced by particle precipitation. Electron density profiles have been measured using time resolutions as short as 0.2 sec and range resolutions of 5 to 10 km. For the shortest integration time, the statistical accuracy of the measurement is on the order of 10%. Results obtained to date show auroral ionization to align with the earth's magnetic field and to have lengths along the field of typically 20 to 30 km and thicknesses across the field of less than 5 km (both distances measured between the half-peak-density points). Within the auroral ionization, the maximum electron density at times approaches 2×10^6 el cm^{-3}. The measured quantities have been analyzed to deduce (a) energy of the particle precipitation, (b) flux of particle precipitation, (c) production rates, and (d) effective recombination coefficients. For a few cases, estimates of the pitch-angle distribution of the primary electrons have been made. (auth)

27585 MEASUREMENT OF THREE-DIMENSIONAL PLASMA VELOCITIES AT THE ARECIBO OBSERVATORY. Hagfors, T.; Behnke, R. A. (National Astronomy and Ionosphere Center, Arecibo, Puerto Rico). Radio Sci.; 9: No. 2, 89-93(Feb 1974).

An observation scheme is described in which it is possible to measure the three velocity components of plasma drift in the ionosphere by using a single monostatic incoherent scatter facility with a steerable antenna. The scheme involves a least-mean-squares fitting of the line-of-sight velocity observed in several different directions to what one would compute from a given set of three orthogonal velocity components. The method is applied to data gathered at the Arecibo Observatory and is shown to be capable of providing velocity information with rms errors of better than 10 m sec^{-1} for all three components with a time resolution of 20 min. (auth)

27586 COMBINED AIRGLOW AND INCOHERENT SCATTER OBSERVATIONS AS A TECHNIQUE FOR STUDYING NEUTRAL ATMOSPHERIC VARIATIONS. Cogger, L. L. (Univ. of Calgary, Alberta); Wickwar, V. B.; Carlson, H. C. Radio Sci.; 9: No. 2, 205-210(Feb 1974).

Night airglow 6300 Å intensities and electron density altitude profiles observed at Arecibo have been combined with dissociative recombination theory to obtain information about the nighttime variation of F-region N_2 and O_2 densities. The application of this technique is illustrated using data from two nights in March 1971. The gross nighttime variation shows reasonable similarity to the Jacchia [1970] model, and also follows the time variation of the measured exospheric temperature. However, on both nights there is evidence of a postmidnight enhancement of the O_2/N_2 density ratio associated with a rapid decrease in the height of the F layer. (auth)

27587 EVIDENCE FOR THE EXISTENCE OF NIGHTTIME F-REGION POLARIZATION FIELDS AT ARECIBO. Behnke, R. A.; Hogfors, T. (National Astronomy and Ionosphere Center, Arecibo, Puerto Rico). Radio Sci.; 9: No. 2, 211-216(Feb 1974).

Recent measurements are presented of F-region ion drifts made at Arecibo using a new continuous beamswinging technique. The measurements are applied to the question of the origin of the F-region electric field over Arecibo. It is shown that the daytime electric fields are probably caused by E-region tidal winds, while the nighttime electric fields appear to be generated in the F region itself by thermospheric winds. (auth)

27588 DAYTIME THREE-DIMENSIONAL DRIFTS AT MILLSTONE HILL OBSERVATORY. Carpenter, L. A.; Kirchhoff, V.W.J.H. (Pennsylvania State Univ., University Park). Radio Sci.; 9: No. 2, 217-222(Feb 1974).

Vertical drift measurements in the topside F region at midlatitudes have confirmed the importance of dynamical processes, but it has been difficult isolating those processes due to E × B drifts from those due to neutral winds. To remove this ambiguity three-dimensional drift measurements were made at Millstone Hill Observatory with the steerable L-band radar in conjunction with the vertical UHF antenna. The geometry of the experiment is discussed and daytime drifts are presented. Unusual lifting of the F-layer peak was observed on two occasions. A reversal in the deduced meridional neutral wind is observed in one case and an enhanced eastward electric field in the other. (auth)

27589 SEASONAL VARIATIONS IN THE THERMOSPHERE ABOVE MILLSTONE HILL. Salah, J. E.; Evans, J. V.; Wand, R. H. (Massachusetts Inst. of Tech., Lexington). Radio Sci.; 9: No. 2, 231-238(Feb 1974).

Incoherent scatter radar measurements gathered since 1969 at Millstone Hill (42.6°N, 71.5°W) are used to study the seasonal variations of the neutral gas temperature, composition and wind velocity in the thermosphere. Between 110 and 120 km, the mean temperature is found to oscillate with a 20 K annual amplitude, 10 K semiannual amplitude, and maxima in July; the mean density oscillates with an annual amplitude of 13% of the mean and a semiannual amplitude of 6% of the mean with maxima in November. Similarly, the mean daily exospheric temperature possesses a 100 K amplitude variation with a maximum in summer; the semiannual component is only about 10 K. Moreover, a weak winter maximum characterizes the neutral density at 400 km, and the neutral wind at 300 km is found to blow northward for a longer period during the day in winter than in summer. The amplitude

and phase of the daily semidiurnal tides in the lower thermosphere do not vary systematically with season but a large variability is observed from day to day, particularly in the phase of the oscillation during winter. In contrast, the semidiurnal harmonic of the exospheric temperature varies seasonally in amplitude and phase and reflects the controlling influence of the length of the day on the shape of the daily temperature oscillation. In the middle thermosphere, the neutral composition ratio O/N_2 is larger in winter than summer, with a rapid transition at the equinox. (auth)

27590 DIURNAL AND LONG-TERM BEHAVIOR OF THE EXOSPHERIC TEMPERATURE AS OBSERVED BY INCOHERENT SCATTER SOUNDING IN THE F_2 REGION. Alcayde, D. (Centre d'Etude Spatiale des Rayonnements, Toulouse). Radio Sci.; 9: No. 2, 239-245(Feb 1974).

A spectral analysis has been performed on the exospheric temperature derived from incoherent scatter data gathered at St. Santin for two unusually long observation campaigns. It is found that the main components of the oscillations are diurnal and semidiurnal, with amplitudes of respectively 10 and 2.5% of the steady component. Based on this evidence the bulk of the data, corresponding to 84 shorter experiments of only about 40 hr, has been Fourier-analyzed in terms of the abovementioned components. The long-term variations of the characteristics of each steady state and of the oscillation components are then analyzed and their implications for the temperature structure are discussed. (auth)

27591 GLOBAL TEMPERATURE DISTRIBUTIONS FROM OGO-6 6300 A AIRGLOW MEASUREMENTS. Blamont, J. E. (CNRS, Verrieres-le-Buisson, Paris); Luton, J. M.; Nisbet, J. S. Radio Sci.; 9: No. 2, 247-251(Feb 1974).

The OGO-6 6300 Å airglow temperature measurements have been used to develop models of the global temperature distributions under solstice and equinox conditions for the altitude region from 240 to 300 km and for times ranging from dawn in this altitude region to shortly after sunset. The distributions are compared with models derived from satellite orbital decay and incoherent scatter sounding. The seasonal variation of the temperature as a function of latitude is shown to be very different from that derived from static diffusion models with constant boundary conditions. (auth)

27592 NEUTRAL COMPOSITION IN THE LOWER THERMOSPHERE. Scialom, G. (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France). Radio Sci.; 9: No. 2, 253-261(Feb 1974).

A photochemical model of the F_1 region was set up from rocket-borne mass spectrometric measurements of the ionic and neutral composition, and from reaction rates determined in laboratory experiments. This model was applied to determine the seasonal variations of the neutral composition in the lower thermosphere from incoherent scatter ionic composition data. An atomic oxygen winter maximum is found, in agreement with satellite drag and energy balance studies. Moreover, a molecular oxygen winter minimum is put in evidence, which confirms results obtained from Lyman-α absorption measurements on O_2, and from twilight 6300 Å airglow studies. (auth)

27593 TIDAL WAVES WITHIN THE THERMOSPHERE. Volland, H. (Univ., Bonn); Mayr, H. G. Radio Sci.; 9: No. 2, 263-273(Feb 1974).

The eigenfunctions of the atmosphere (the Hough functions within the lower atmosphere below about 100 km) change their structure and their propagation characteristics within the thermosphere due to dissipation effects such as heat conduction, viscosity, and ion drag. Wave dissipation can be parameterized to a first-order approximation by a complex frequency, the imaginary term of which simulates an effective ion drag force. It is shown how the equivalent depth, the attenuation, and the vertical wavelength of the predominant symmetric diurnal tidal modes change with height as functions of effective ion drag. The boundary conditions of tidal waves are discussed, and asymptotic solutions for the wave parameters like pressure, density, temperature, and wind generated by a heat input proportional to the mean pressure are given. Finally, diffusion effects upon the minor constituents within the thermosphere are described. (auth)

27594 OBSERVATION OF NEUTRAL TEMPERATURE TIDAL-TYPE OSCILLATIONS IN THE F_1 REGION. Fontanari, J.; Alcayde, D. (Centre d'Etudes Spatiale des Rayonnements, Toulouse). Radio Sci.; 9: No. 2, 275-280(Feb 1974).

Incoherent scatter data gathered at St. Santin yield a determination of the ionic (neutral) temperature in the F_1 region. Although large uncertainties are present in these data, a study of their short-term variations is possible provided they have been statistically combined in typical periods. It is shown that waves of tidal type are present in the lower thermosphere, with dominant periods of 24 and 12 hr. Seasonal variations are found in good agreement with exospheric temperature observations. Comparisons of experimental results with relevant theoretical works show a rather good general agreement. As concerns the semidiurnal component, Lindzen and Hong's work shows the possible presence of two modes in the thermosphere: a trapped mode generated in situ, and a propagating one generated below 100 km; however, experimental results suggest a rapid damping of the propagating mode above 180 km, while the in-situ excited mode dominates. (auth)

27595 TIDAL OSCILLATIONS OF THE MERIDIONAL NEUTRAL WIND AT MIDLATITUDES. Amayenc, P. (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France). Radio Sci.; 9: No. 2, 281-293(Feb 1974).

The meridional neutral wind values estimated over St. Santin (44°65′N, 2°19′E, geographic) from incoherent scatter observations, during the years 1971 and 1972, have been analyzed in terms of Fourier components in the whole thermospheric altitude range. Seasonal averages of the height structure of amplitude and phase for each harmonic term are presented and compared with relevant theoretical predictions. The high thermosphere results exhibit clear annual and semiannual effects and the steady meridional wind is found to depend on magnetic activity and solar flux. The discussion of the experimental results, in connection with predictions of the tidal theory, suggests future work in this field which is outlined in the conclusion. (auth)

27596 MIDLATITUDE THERMOSPHERIC WINDS FROM INCOHERENT SCATTER RADAR AND THEORY. Salah, J. E. (Massachusetts Inst. of Tech., Lexington); Holt, J. M. Radio Sci.; 9: No. 2, 301-313(Feb 1974).

Ionospheric plasma vertical drifts measured by the Millstone Hill incoherent scatter radar are decomposed into estimates of meridional neutral particle motion by accounting for ion diffusion and semidiurnal electric fields. For two equinoctial days with relatively high F-region electron densities the resulting neutral circulation at 300 km is composed of equatorward winds of 100 to 150 m sec^{-1} at night and poleward winds of 25 to 50 m sec^{-1} during the day. Harmonic analysis of the wind pattern yields a diurnal northward component of 80 to 100 m sec^{-1} with a maximum near noon, a semidiurnal component of 35 m sec^{-1} at 0600 LT and a prevailing southward wind of about 20 m sec^{-1}. The observations are compared with tidal theory predictions and are interpreted by means of a simplified integration of the horizontal equations of motion through which effects of zonal advection, ion drag, viscosity, and pressure gradients are studied. Although the observed wind pattern is consistent in general with that derived from global models based on satellite drag observations, various discrepancies concerning the amplitude and phase of the diurnal bulge are noted and discussed. (auth)

27597 SIMULTANEOUS MEASUREMENT OF ION AND NEUTRAL MOTIONS BY RADAR AND OPTICAL TECHNIQUES. Nagy, A. F. (Univ. of Michigan, Ann Arbor); Cicerone, R. J.; Hays, P. B.; McWatters, K. D.; Meriwether, J. W.; Belon, A. E.; Rino, C. L. Radio Sci.; 9: No. 2, 315-321(Feb 1974).

The results of simultaneous thermospheric neutral wind and ionization drift measurements from near College, Alaska ($L = 5.6$, $\Lambda = 65°$) are presented. The neutral wind data were obtained by observing the Doppler shift of the 6300 Å atomic oxygen line with the 15-cm Fabry–Perot interferometer of the Michigan Airglow Observatory which is located temporarily at Ester Dome, Alaska. Ionization drifts were measured by the Chatanika incoherent scatter radar facility. These simultaneous measurements indicate that in the premidnight sector both the neutral wind and the ionization drift are generally westward. This westward ionization drift is consistent with the general magnetospheric convection pattern but the measured neutral wind is in a direction opposite to the diurnal pressure gradients and thus must be driven by ion drag. In the postmidnight sector the ionization drift turns eastward while the neutral wind direction turns south. Again, the ion drift is consistent with previously published results; the reasons for the absence of significant zonal neutral winds and the significant southward meridional wind in the postmidnight sector are not well understood at this time, but are probably a combination of a decrease in the ion drag force following magnetic midnight, Coriolis force, and pressure gradients due to both the diurnal and auroral heat sources. (auth)

27598 HIGH RESOLUTION D-REGION MEASUREMENTS AT ARECIBO. Ioannidis, G.; Farley, D. T. (Cornell Univ., Ithaca, NY). Radio Sci.; 9: No. 2, 151-157(Feb 1974).

D-region electron densities have been measured with a height resolution of less than 1 km using the incoherent scatter technique with coded pulses. Using a theoretical production model and the measured densities, recombination coefficients were computed for

the altitude range from 80 to 95 km. The effective recombination coefficient decreases across the D-region ledge from a value of about 2×10^{-5} cm^3 sec^{-1} below the ledge to a value of the order of 1 to 5×10^{-7} above. The change is presumably due to a transition from water cluster ions to the molecular ions NO^+ and O_2^+. (auth)

27599 PHYSICS AND CHEMISTRY OF THE E REGION: A REVIEW. Strobel, D. F. (Kitt Peak National Observatory, Tucson, AZ). Radio Sci.; 9: No. 2, 159-165(Feb 1974).

A review of physical and chemical processes in the E region is given with emphasis on the absolute ionization balance and relative ion composition. The importance of transport processes in the nighttime E region is emphasized. It is concluded that the electron, ion, and neutral gases are in thermal equilibrium. (auth)

27600 NORMAL AND ABNORMAL E-REGION ELECTRON DENSITY PROFILES AT A MIDLATITUDE STATION. Taylor, G. N. (Royal Radar Establishment, Malvern, Eng.). Radio Sci.; 9: No. 2, 167-174(Feb 1974).

The problems of measuring reliable E-region electron density vs. height profiles with a vertically pointing, pulsed incoherent scatter radar are discussed, and profiles from heights of 90 km upward observed at Malvern are presented. The minimum above $h_{max}E$ is more pronounced in winter than in summer, and the overall average density in the minimum is 92% of $N_{max}E$. From the observational point of view profiles showing an unresolved sporadic-E layer seen merely to be an extreme case of the normal type. Many layers are present in the E region at night; the behavior of these is erratic except for the principal layer centered just below 100 km, which may be meteoritic in origin. Incoherent scatter offers a new method of investigating the effects of solar flares in the 100 to 130 km range; observations taken during a flare, and also during a partial solar eclipse and on a magnetically disturbed day, are described. (auth)

27601 MAGNETIC ACTIVITY VARIATIONS OF THE NIGHTTIME E REGION AT ARECIBO. Rowe, J. F. Jr. (National Astronomy and Ionosphere Center, Arecibo, Puerto Rico). Radio Sci.; 9: No. 2, 175-182(Feb 1974).

Using 13-bit Barker-coded pulses, high resolution (0.9 km) incoherent scatter measurements of nighttime E- and F-region electron densities have been conducted at Arecibo. Electron density profile sequences are presented for four nights characterized by a wide range of magnetic activity. The data show a deep valley in electron density above 120 km during quiet periods which fills in with plasma to levels of 10^4 cm^{-3} during a magnetic storm (Kp ≈ 8). An intermediate layer frequently appears near 125 km, independently of magnetic activity. In view of the observations, the connection between nighttime valley content and magnetic activity is discussed. (auth)

27602 SOME PROBLEMS OF THE F REGION. Rishbeth, H. (Appleton Lab., Slough, Eng.). Radio Sci.; 9: No. 2, 183-187(Feb 1974).

Some of the currently outstanding problems of F region theory are outlined. It is suggested that a basic understanding of F region storm phenomena now exists, and an outline description of the main processes operating at middle and low latitudes during storms is given. (auth)

27603 F_1 REGION DURING A SOLAR ECLIPSE. Oliver, W. L.; Bowhill, S. A. (Univ. of Illinois, Urbana). Radio Sci.; 9: No. 2, 189-195(Feb 1974).

Temperature and ion composition results obtained during the eclipse of 7 March 1970 at Millstone Hill are presented. The temperature variations appear to be controlled by the high degree of magnetic activity present on the eclipse day. Ion composition variations may be explained in terms of photochemical processes and the distribution of ionizing radiation across the solar disk. The data indicate the quality of ion composition determination by incoherent scatter radar, and it is concluded that these data are more useful when averaged in quantity to determine diurnal, seasonal, and solar cycle variations rather than short-term temporal variations on a given day. (auth)

27604 INCOHERENT SCATTER OBSERVATIONS OF THE IONOSPHERIC RESPONSE TO A LARGE SOLAR FLARE. Mendillo, M. (Air Force Cambridge Research Labs., Bedford, MA); Evans, J. V. Radio Sci.; 9: No. 2, 197-203(Feb 1974).

Incoherent scatter observations at Millstone Hill were made during the importance 3B solar flare which occurred at 15:00 UT on 7 August 1972. Measurements were obtained of the electron density profile over the height range 125 to 1200 km, together with observations of the electron temperature, ion temperature, and vertical drift velocity above 225 km. The $N_e(h)$ results showed electron density enhancements of nearly 100% at 125 km and 60% at 200 km; N_e enhancements were also observed throughout the topside, with the percentage enhancement increasing with height above 400 km. The total electron content up to 1200 km showed an increase of 3.8×10^{16} el m^{-2} (≈30%). The temperature and drift data represent the first Thomson scatter measurements of these parameters during flare conditions. While the electron temperature results showed substantial increases at all altitudes examined, the ion temperatures were only slightly perturbed. The drift data provided the most interesting results. In response to the flare, a dramatic upward surge was observed in which the drifts increased nearly linearly with height over the height range 300 to 750 km. In discussing the overall results obtained during this event, estimates are made of the flare-induced electrodynamic and thermal processes which contribute to the observed effects. (auth)

27605 RECENT DEVELOPMENTS AND OUTSTANDING PROBLEMS IN THE THEORY OF THE D REGION. Thomas, L. (Science Research Council, Slough, Eng.). Radio Sci.; 9: No. 2, 121-136(Feb 1974).

The present understanding of the ionization processes, and of the positive and negative ion chemistry of the D region is reviewed with particular attention being given to outstanding problems. Rocket-borne mass spectrometer observations carried out in the past decade have shown that the change in positive ion composition with height (from NO^+, O_2^+ and metallic ions above to water cluster ions $H^+ \cdot (H_2O)_n$ below) is a general feature of the D region at all latitudes and under all geophysical conditions. Furthermore, these observations indicate that this change occurs over a very small range of heights, between 82 and 86 km under normal conditions and at lower heights during auroral or Polar Cap Absorption conditions. These results are discussed in terms of current ideas concerning the formation of water cluster ions from O_2^+ and NO^+ ions. Mass spectrometer observations by two experimental groups have provided conflicting results concerning the negative ion composition in the D region and cannot be used to test theoretical models. Such models have been derived from laboratory measurements, and involve reaction schemes leading from O_2^- ions, formed by electron attachment, to ions O_3^-, O_4^-, CO_3^-, CO_4^-, NO_2^- and NO_3^-. The effect on these models of including recent laboratory measurements of negative ion hydration is considered, and the importance of photodetachment is also mentioned. (auth)

27606 COMPARISONS OF TECHNIQUES FOR MEASUREMENT OF D-REGION ELECTRON DENSITIES. Sechrist, C. F. Jr. (Univ. of Illinois, Urbana). Radio Sci.; 9: No. 2, 137-149 (Feb 1974).

The ground-based and rocket techniques that are presently being used to determine electron density profiles in the ionospheric D region are reviewed. Ground-based techniques include VLF, LF, and MF sounding, differential absorption and differential phase using partial reflections, wave interaction, and incoherent scatter. Rocket techniques include differential absorption and Faraday rotation in association with high-resolution dc probes calibrated by means of the radio measurements. The characteristics of the aforementioned techniques are presented, including time and height resolution, accuracy estimates, preferred height ranges, and problems encountered. Electron density profiles obtained with these techniques are presented for comparable solar zenith angles and undisturbed solar and geophysical conditions, and variances are described. (auth)

27607 RELATION OF LOWER IONOSPHERE CONDUCTIVITY PROFILES TO elf WAVE PROPAGATION AND RESONANCES IN THE EARTH-IONOSPHERE WAVEGUIDE. Tran, A. Kingston, RI; Univ. of Rhode Island (1973). 138p. University Microfilms Order No. 73-28,017.

Thesis (Ph. D.).

In treating ELF wave propagation in the Earth-Ionosphere cavity, the flat earth approximation may be derived from the exact equations for the spherical cavity by introducing a second order or Debye approximation for the spherical Hankel functions. In the frequency range 3 to 30 Hz, however, the assumed conditions for the Debye approximation are not satisfied. For this reason an exact evaluation of the spherical Hankel functions is used to study the effects of the flat earth approximation on various propagation and resonance parameters. By comparing the mode or resonance equation for a spherical cavity and its flat earth counterpart and by assuming that the surface impedance Z_1 is known, the relation between the eigenvalue ν and S_ν, the sine of the complex angle of incidence at the lower ionosphere boundary, is established as $\nu(\nu + 1) = (kaS_\nu)^2$. It is also shown that the approximation $\nu(\nu + 1) \cong (\nu + \frac{1}{2})^2$ which was used by some authors is not adequate. Numerical results for both, spherical and planar stratification show: (1) For a given cavity height planar stratification is adequate for the computation of resonance frequency to within 0.1 Hz; (2) Planar stratification will lead to errors in cavity Q and wave attenuation which increase with frequency; (3) Computation of resonance frequencies to within 0.1 Hz requires the extension of

the lower boundary of the ionosphere to a height where $(\sigma/\omega\epsilon_0)$ is less than 0.3; (4) Atmospheric conductivity should be considered down to ground level in computing cavity Q and wave attenuation. The Schumann resonance frequencies of the Earth-ionosphere cavity at approximately 8, 14, and 20 Hz provide a method for obtaining a world average of the (zero-magnetic field) electrical conductivity of the "ionosphere" down to 40 km altitude. If the cavity Q or wave attenuation can be accurately measured, the average electrical conductivity below 40 km can also be determined. Numerical models are analyzed to show the effect of conductivity changes at various altitude ranges upon the resonance frequencies. Several conductivity profiles for periods corresponding to different levels of solar activity are derived from experimentally determined Schumann resonance frequencies. The measured bandwidth or "Q" of the Schumann resonances is used to extend to ground level the electrical conductivity profiles which were previously computed (in "Part II") for the 40 km to 100 km altitude range from the experimentally determined values of the resonance frequencies. It is also shown that the conductivity profile in the 60 km to 75 km altitude range cannot be determined uniquely from ELF data since it depends upon the value of conductivity selected for the 0 to 40 km region. The profile for the 60 km to 75 km altitude range becomes unique only if the mean conductivity for the bottom layer (0 to 40 km) is specified. Since available balloon data and existing theory suggest a mean conductivity of the order of 2.0 (10^{-11}) mho m^{-1} for that layer, the lowest value of conductivity consistent with ELF data was selected; it is 3.35 (10^{-11}) mho m^{-1}. (Diss. Abstr. Int., B)

27608 INCOHERENT-SCATTER OBSERVATIONS OF AURORAL IONIZATION IN THE E-REGION. Baron, M. J. Stanford, CA; Stanford Univ. (1973). 163p. University Microfilms Order No. 73-30,359.

Thesis (Ph. D.).

The first systematic incoherent-scatter measurements of auroral ionization are described. The incoherent-scatter technique is based upon the use of a high-powered radar system whose waves penetrate auroral forms and are scattered from individual electrons. Past studies of auroral ionization using other techniques have been limited by a number of factors: poor time resolution, limited temporal coverage, poor spatial resolution, and the necessity of using many assumptions and approximations regarding the applicable physics and chemistry. The incoherent-scatter technique largely overcomes these limitations and permits electron concentration measurements having good temporal and spatial resolution. The data for this study were obtained using the incoherent-scatter radar located at Chatanika, Alaska (latitude 65 degrees North). Hardware and computer software were developed that have become a basic part of the radar system and are now routinely used by all scientists conducting experiments with the radar. Data are presented that show the temporal and spatial behavior of auroral ionization. Most of the measurements were made during local nighttime when particle precipitation is the primary mechanism responsible for the production of ionization in and near the ionospheric E-region (70-150 km altitude). Greatly enhanced electron concentrations occur coincident and colocated with auroral optical emissions. Occasionally, similar enhancements are observed during the daytime when optical observations are not possible. (Diss. Abstr. Int., B)

27609 SOME RESULTS OF EXPERIMENTS STUDYING THE RELATIONSHIP OF THE UPPER ATMOSPHERIC TEMPERATURE WITH SOLAR AND GEOMAGNETIC ACTIVITY. Ivanova, I. N.; Kokin, G. A. Izv. Akad. Nauk SSSR, Fiz. Atmos. Okeana; 9: 882-884(Aug 1973). (In Russian).

27610 STRATOSPHERIC OZONE DEPLETION AND SOLAR ULTRAVIOLET RADIATION ON EARTH. Cutchis, P. (Inst. for Defense Analyses, Arlington, VA). Science; 184: No. 4132, 13-19(5 Apr 1974).

No attempt is made to assess the percentage of ozone depletion that may be expected from a fleet of stratospheric aircraft, but the factor of increase in uv radiation as a function of percentage ozone depletion and wavelength is estimated. (WDM)

27611 BALLOON RECORDINGS OF AURORAL-ZONE X-RAYS FROM NORTHERN NORWAY IN JULY–AUGUST 1965. Trefall, H.; Bronstad, K.; Pytte, T.; Stadsnes, J.; Bjodal, J. (Univ., Bergen). SPARMO Bull.; 5: 111-152(Jun 1973).

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Refer also to abstract 27517.

27612 PENETRATION OF SOLAR COSMIC RAYS INTO THE EARTH'S POLAR CAPS. Gotselyuk, Yu. V.; Kuznetsov, S. N.; Logachev, Yu. I.; Savenko, I. A.; Stolpovskii, V. G. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 4, 569-572(1973).

Translated from Kosm. Issled.; 11: No. 4, 635-638(1973).

On board KOSMOS-378 were an n-p detector, which recorded 1- to 8-MeV protons and parallel to it an end-window gas-discharge counter SBT-9, which recorded electrons with energy E > 40 keV and protons with energy E > 0.5 MeV in the solid angle ~ 0.1 sr. Data obtained from these two counters in the polar caps from Nov. 17 through Dec. 2, 1970 are discussed. (WDM)

27613 COMPREHENSIVE INVESTIGATIONS OF CORPUSCULAR RADIATION IN UPPER ATMOSPHERE OF CENTRAL LATITUDES IN A PERIOD OF GEOMAGNETIC DISTURBANCES. Tulinov, V. F.; Feigin, V. M.; Zhuchenko, Yu. M.; Lipovetskii, V. A. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 4, 562-565 (1973).

Translated from Kosm. Issled.; 11: No. 4, 628-632(1973).

In the period from Sept. 24 through Oct. 8, 1971, which was characterized by considerable variation of geomagnetic activity, six MR-12 meteorological rockets with apparatus for investigations of corpuscular fluxes were launched from the Volgograd base. The corpuscular flux data obtained and the relationship between the change in the characteristics of the corpuscular radiation and the change in the state of the geomagnetic field are discussed. (WDM)

27614 RELATIONSHIP BETWEEN HIGH-ENERGY ELECTRON FLUXES AT HEIGHTS OF 200 TO 300 KM AND THRESHOLD RIGIDITY. Basilova, R. N.; Grigorov, N. L.; Kalinkin, L. F.; Pugacheva, G. I.; Pryakhin, E. A.; Savenko, I. A. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 4, 560-561(1973).

Translated from Kosm. Issled.; 11: No. 4, 627-628(1973).

Measurements of the fluxes of electrons with energies $E \geq 80$ MeV were made by the satellite Kosmos-490 from May 17 through May 25, 1972. The instrument measured the energy of the electrons and the direction of their arrival. (WDM)

27615 LATITUDINAL DISTRIBUTIONS AND COMPOSITION OF RADIATION ON OPEN DRIFT SHELLS IN THE ALTITUDE RANGE 200 TO 400 KM. Tsaplin, V. S.; Shavrin, P. I.; Savun, O. I. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 4, 503-511 (1973).

Translated from Kosm. Issled.; 11: No. 4, 563-573(1973).

An account of the results of measurements made on the satellites Kosmos 136, Kosmos 137, and Kosmos 219 in 1966-1967 is given. The latitudinal distributions of radiation in different energy ranges in the region with $h_{min} < 0$ were obtained. A relationship between the intensity of the soft component and the geomagnetic activity was found. Information regarding the composition of the radiation on open drift shells in a wide range of latitudes is derived from a comparison of the data of various detectors. The paper concludes with a brief review of the results of measurement of local radiation on different vehicles. (auth)

27616 INFLUENCE OF NONADIABATIC EFFECTS DURING MAGNETIC STORM ON PROTON BELT DYNAMICS. Il'in, V. D.; Il'ina, A. N.; Kuznetsov, S. N. Cosmic Res. (USSR) (Engl. Transl.); 11: No. 4, 499-502(1973).

Translated from Kosm. Issled.; 11: No. 4, 559-562(1973).

The mechanism of nonadiabatic proton losses from the radiation belts is considered. It is shown that $D_{\alpha\alpha}$ variations in the geomagnetic field lead to a nonadiabatic decrease in the intensity of protons with energies of several tens of MeV. (auth)

27617 MAGNETOSPHERIC IMPLICATIONS OF THE NONLINEAR WHISTLER INSTABILITY OBTAINED IN A COMPUTER EXPERIMENT. Cuperman, S. (Univ. of Colorado, Boulder); Salu, Y. J. Geophys. Res.; 78: No. 22, 4792-4796(1 Aug 1973).

The determination of the electron trapping limit in the magnetosphere, namely the rate of growth of the whistler waves is determined. In order to obtain a fully nonlinear theory taking into account the interaction between the various instability modes, a computer simulation experiment is performed in which the nonlinear behavior of the plasma system (waves plus particles) is correctly investigated. (JFP)

27618 PIONEER 8 OBSERVATIONS AND INTERPRETATIONS OF SIXTEEN INTERPLANETARY SHOCK WAVES OBSERVED IN 1968. Bavassano, B. (Univ., Rome); Mariani, F.; Ness, N. F. J. Geophys. Res.; 78: No. 22, 4535-4546(1 Aug 1973).

A study was made of 16 interplanetary shock waves observed in 1968 by Pioneer 8 at large distances from earth. A comparison with the shapes of interplanetary shock fronts obtained by De Young and Hundhausen (1971) suggests that in general the ejection of flare gas occurs within a cone of half-angle between 30 and 60°. For near-earth events a deflection of the shock front was observed, possibly owing to an interaction with the bow shock. The average duration of the post shock perturbation is about 20 hours. Strong magnetic fields and rapid fluctuations occur during

the first 6 to 12 hours. Electric field perturbations in the VLF band are also noted during these periods. There is limited evidence for one corotating shock in these data. Unfortunately, no plasma data are available for the comparison and the interpretation of corresponding analyses. (auth)

27619 EARTH'S MAGNETOSPHERE. Roederer, J. G. (Univ. of Denver). Science; 183: No. 4120, 37-46(11 Jan 1974).

A qualitative description of the general magnetospheric configuration is presented and some of the physical processes governing the magnetosphere that are the main targets of current research are discussed. (41 references) (WDM)

27620 NONLINEAR INTERACTION OF ION-CYCLOTRON WAVES IN THE MAGNETOSPHERE. Gokhberg, M. B.; Pokhotelov, O. A.; Perrot, S.; Wehrlin, N.; Vildari, K. (Inst. of Earth's Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 9, 327-328(5 Nov 1973).

Translated from Zh. Eksp.Teor. Fiz., Pis'ma Red.; 18: No. 9, 554-557(5 Nov 1973).

Nonlinear interaction of ion-cyclotron waves in the magnetosphere, which is manifest in a periodic exchange of energy between the waves, was observed and investigated experimentally. (auth)

27621 GENERATION AND PROPAGATION OF ELECTROMAGNETIC WAVES IN THE MAGNETOSPHERE. Taylor, W. W. L. Iowa City, IA; Univ. of Iowa (1973). 140p. University Microfilms Order No. 73-30,992.

Thesis (Ph. D.).

Characteristics of broadband ELF, VLF, and LF emissions in the magnetosphere have been calculated assuming incoherent Cerenkov radiation from magnetospheric electrons with energies from 50 eV to 50 keV. Calculations were included to determine the ray paths of the emitted waves. A diffusive equilibrium model of the magnetosphere with an ionosphere, plasmapause, and a centered dipole magnetic field was used. Ray path calculations were done in three dimensions. (Diss. Abstr. Int., B)

27622 RING CURRENT INDUCTIVE ELECTRIC FIELDS AND THEIR EFFECT ON THE MOTION OF CHARGED PARTICLES IN THE EARTH'S MAGNETOSPHERE. Murphy, C. H. Albany; State Univ. of New York (1973). 123p. University Microfilms Order No. 73-31,184.

Thesis (Ph. D.).

The generation of inductive electric fields in the earth's magnetosphere and the effect of these electric fields on the motion of charged particles has been considered. The inductive electric fields investigated were those produced by the time-dependent behavior of the magnetospheric ring current. Two models of the ring current were considered. First, a distributed current due to protons drifting in a dipole magnetic field was used to represent the symmetric ring current of the geomagnetic storm. Second, a more complex configuration was used to represent the asymmetric ring current which exists during the magnetic substorm. This asymmetric ring current model included ionospheric currents and an eastward flowing partial ring current in the midnight sector. The current in both models was assumed to decay exponentially with time, thereby generating the inductive electric field. (Diss. Abstr. Int., B)

27623 INTERPLANETARY FIELDS AND PLASMA: THEIR TERRESTRIAL EFFECTS ON GEOMAGNETIC STORMS. Wiskerchen, M. J. Denver; Univ. of Denver (1973). 101p. University Microfilms Order No. 73-28,538.

Thesis (Ph. D.).

An investigation has been made into the relationship between large geomagnetic storms and the near earth interplanetary medium. A total of 25 magnetic storm events were selected, from which, detailed comparisons were made between the interplanetary fields and plasma data from Explorer 33 and 35 and the hourly equational Dst Field. The results of the study indicate that the interplanetary magnetic field plays a significant role in the development of the main phase of a geomagnetic storm. A negative or decreasing z component of the interplanetary magnetic field was found to be a necessary, but not sufficient condition, for the storm main phase to commence. In addition, the y component variation of the interplanetary magnetic field was shown to correspond to Dst variations during the main phase. (Diss. Abstr. Int., B)

27624 GENERATION AND PROPAGATION OF VLF EMISSIONS. Barrington, R. E. (Communications Research Centre, Shirley Bay, Ottawa). pp 157-167 of Collection of Articles on Cosmic Geophysics. Holtet, J. (ed.). Oslo; Universitetsforlaget (1972).

A survey of the established features of vlf emissions is given. The characteristics of the propagation of emissions in the magnetosphere and ionosphere are reviewed with emphasis on those topics that are important in determining the regions in which emissions are generated. Both single particle and collective processes that have been studied as possible sources of vlf emissions are discussed. A number of recent experiments involving rockets and satellite-borne instruments have provided new clues to the generation process and these are briefly summarized. (auth)

27625 EARTH ALBEDO AND SOLAR NEUTRONS. White, R. S.; Moon, S.; Preszler, A. M.; Simnett, G. M. (Univ. of California, Riverside). pp 683-687 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

Measurements of the energy spectra and angular distributions of earth albedo neutrons from 10 to 100 MeV are reported. The measurements were made at 40 deg N geomagnetic latitude from a balloon at 116,000 ft. The fluxes of upward moving neutrons at angles of 20 to 70 deg to the vertical show that the intensities of lower energy neutrons are peaked near the vertical. The distributions are integrated over angle to give a vertical energy distribution for upward moving neutrons that is flat to 50 MeV, then falls with energy. The absolute neutron flux is of the correct strength and the energy distribution is of the correct shape for the albedo neutrons to be the source of the protons trapped in the earth's inner radiation belt. (auth)

27626 AERODYNAMICS OF A SPHERE MOVING SLOWLY IN HIGHLY DILUTE PLASMA. Kuryshev, A. P.; Filippov, B. V. Vestn. Leningrad. Univ., Mat., Mekh., Astron.; No. 3, 114-119 (Jul 1973). (In Russian).

Stationary functions of the distribution of ions flying towards the ion body, the speeds of the body being $V \leq v_{T_u}$, are plotted in accordance with the solution of Vlasov's set of kinetic equations in combination with the equations for electrostatic potential φ (v_{T_u} — thermal speed of ions). The plotted functions of distribution are used to estimate in the first approximation the resistance force coefficients of a negatively charged sphere in the considered speed range; the solution of a spherically symmetric problem of determining φ with $V = 0$ is applied as a dependence $\varphi(r,\theta)$ (r,θ— spherical coordinates). (auth)

27627 OBSERVATIONAL COMPARISON WITH A SELF-CONSISTENT MODEL OF THE GEOMAGNETIC TAIL. Bird, M. K. (Univ., Bonn). pp 655-660 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

Magnetic field and particle flux observations by space probes in the distant geomagnetic tail (more than 50 earth radii) are compared with a theoretically derived magnetotail for which the magnetic field and current configuration are self-consistent in the adiabatic and magnetohydrodynamic sense. The thickness of the observed plasma and neutral sheets is seen to be in good agreement with the model. The largest source of distant magnetotail field is found to be due to former solar wind particles drifting from the dawn to the dusk magnetosheath approximately within the quasi-neutral sheet. (auth)

27628 SECULAR MAGNETIC VARIATION AND INNER ZONE PROTONS. Hilton, H. H. (Aerospace Corp., El Segundo, CA). pp 625-629 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

The secular variation of the earth's magnetic field has important consequences concerning the steady-state inner zone of energetic protons. One consequence is the decrease in minimum altitude for particles having a constant flux invariant and a constant invariant parameter K, which affects the rate at which particles lose energy to free and bound atmospheric electrons. It is found that, for equatorially mirroring particles at a nominal L = 1.10, the minimum mirror altitude decreases at a rate of 6 km/year using the IGRF (1965.0) model for the earth's magnetic field, and at a rate of 11 km/year using the POGO (8/69) model. Another consequence is the increase in the magnitude of the mirror-point field, resulting in an increase of about 0.15% per year in a particle's energy. (auth)

27629 HIGH ENERGY ELECTRONS AT THE MAGNETOPAUSE ABOVE THE NORTH POLE: PRELIMINARY RESULTS FROM THE HEOS 2 SATELLITE. Page, D. E. (European Space Research and Tech. Centre, Noordwijk, Netherlands); Domingo, V.; Kohn, D.; Taylor, B. G.; Wenzel, K. P.; Hedgecock, P. C. pp 631-637 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

Preliminary results are presented on five magnetopause crossings at high ecliptic latitude observed by the particle and magnetometer experiments on HEOS 2. There appears to be a permanent layer of high energy electrons (40 keV to about 2 MeV) at the magnetopause above the north pole. The flux in this layer and the

degree of the magnetic field change at the boundary tend to increase with geomagnetic activity indicated by the Kp index. On the other hand, it would seem that the high energy electron flux in the well ordered part of the tail may decrease with increasing Kp. (auth)

27630 ENERGETIC PROTONS AT LOW L-VALUE OF THE EQUATORIAL MAGNETOSPHERE. Moritz, J. (Univ., Kiel). pp 669-674 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

At L-values between 1.00 and 1.14 and low magnetic latitudes an apparently trapped proton population with energies in the range 0.25 to 1.65 MeV has been detected with a solid state detector telescope on board the German Research Satellite Azur. This proton population was seen during the active life of the satellite on the evening and the morning side of the satellite's polar orbit depending on the position of perigee. The measured protons are strongly concentrated along the geomagnetic equator, and their distribution shows little or no dependence on the altitude, the L-value, and the geographic longitude of the site of measurement. A possible source for this energetic proton population is a local charge exchange reaction with fast H-neutrals that originates from charge exchange processes within the outer proton radiation belt. (auth) (IAA)

27631 INFLUENCE OF THE POLARITY OF THE INTERPLANETARY MAGNETIC FIELD ON MAGNETIC ACTIVITY AT HIGH LATITUDES. Berthelier, A.; Guerin, C. (Groupe de Recherches Ionospheriques, Val-de-Marne, France). pp 661-667 of Space Research XIII. Vol. 2. Berlin; Akademie-Verlag GmbH (1973).

From 15th plenary meeting; Madrid, Spain (10 May 1972).

Relations between the polarity of the interplanetary magnetic field (IMF) and magnetic activity have been investigated using a large number of data related to about 70 solar rotations. A precise statistical analysis enabled us to study some of the principal aspects of the effect of the polarity of the IMF on geomagnetic variations. A field "away" from the sun gives a higher magnetic activity on the earth's surface in the Northern Hemisphere, and the intensity of the effect depends both on invariant latitude and magnetic local time. (auth) (IAA)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstract 27449.

27632 (CONF-740104-20) NEUTRON SPUTTERING OF GOLD. Kirk, M. A.; Blewitt, T. H.; Klank, A. C.; Malewicki, R.; Scott, T. L. (Argonne National Lab., Ill. (USA)). Feb 1974. 7p. Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

The sputtering yield of gold bombarded with fission neutrons was studied in the CP-5 reactor. Bulk single crystals were used at near liquid helium temperature. Overall sputtering yields ranged from 1×10^{-3} to 6×10^{-3} sputtered gold atoms per incident neutron for doses ranging from 2.1×10^{17} to 5.5×10^{17} (nvt > 0.1 MeV). Results are roughly an order of magnitude larger than many previously reported sputtering yields. Sputtering patterns have not been pursued yet, due to sufficiently high background radiation. (auth)

27633 (ORNL-TM-4426, pp 65-66) ION SOURCE PROJECT. Jones, C. M. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22-23, 1973.

A group was formed for the advancement of heavy ion source technology with particular emphasis on negative heavy ion sources for use with tandem accelerators and highly charged positive ion sources for use with cyclotrons and linear accelerators. Prototype ion sources will be built and studied, and also some of the basic physical phenomena important in ion sources will be studied. (JFP)

27634 (ORNL-TM-4426, pp 132-137) ENERGY SHIFTS AND RELATIVE INTENSITIES OF K X RAYS PRODUCED BY SWIFT HEAVY IONS. Saltmarsh, M. J.; van der Woude, A.; Ludemann, C. A. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22-23, 1973.

The energy shifts produced by 5-MeV/amu He, C, O, and Ne ions, and by 10-MeV/amu C ions on targets of Fe, Co, Ar, and Sn. It was found that for each target there exists a nearly linear relation between the observed energy shift and the stopping power for the bombarding ion. This suggests that these multiple ionization phenomena can be quantitatively explained within the framework of existing Coulomb excitation theories if such theories are formulated to extract the impact parameter dependence of the ionization cross sections. (JFP)

27635 ELECTRICAL MEASUREMENTS OF MASS RESOLVED ION BEAMS. Conzemius, R. J.; Svec, H. J. (Ames Lab., IA). pp 135-177 of Trace Analysis by Mass Spectrometry. New York; Academic Press, Inc. (1972).

The special considerations used in developing electrical systems for electrical detection of ion currents from the spark source and some of the preliminary results obtained with them are reviewed. (JFP)

27636 UNITED ACTION OF THE ELECTRON AND THE RADIATION FIELD ON A MOLECULE. Kudrevatova, O. V. Teor. Mat. Fiz.; 18: No. 3, 401-409(Mar 1974). (In Russian).

Collision of an electron with a molecule in radiation field is investigated. The problem is solved by means of a method proposed earlier by V. S. Butylkin and O. V. Kudrevatova, which makes it possible to take into account the effects of many-quanta transitions already in the first of the successive approximations. The expressions are obtained, which demonstrate the distinction of the process of the ionization of molecule with quasi-immovable nuclei from that of its excitation, up to the ionization threshold. The equation for the oscillator wave function is found as well as the equations describing the dependence of the ionization process on the molecule oscillations. It is shown that the united action on the molecule of the electron collision and the radiation field in the electron motion makes stronger effect in the ionization of the molecule, and in the oscillating motion in the excitation of the latter, if compared with the action of the radiation only. (auth)

27637 CONTROLLABLE SECONDARY ELECTRON EMISSION AT HIGH ENERGIES. Lorikyan, M. P.; Kavalov, R. L.; Trofimchuk, N. N. (Erevan State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; R8: No. 1, 33-36(1973). (In Russian).

Results of experimental investigation of controllable secondary electron emission from KCl low-density dielectric films of different thicknesses and densities in high electric field at the passage of 50-MeV electrons are given. (auth)

27638 MEASUREMENTS OF THE CHANNELING EFFECT IN SPUTTERING. Zwangobani, E.; MacDonald, R. J. (Australian National Univ., Canberra). Radiat. Eff.; 20: No. 1-2, 81-88(1973).

Single crystals of germanium and indium antimonide, rotated about axes normal to their surfaces were bombarded with 5 to 15 keV neon, argon and krypton ions. The resultant variation of the sputtering yield with the angle of ion incidence was followed by means of a modulated mass spectrometric technique capable of monitoring one or more masses in the form of sputtered neutrals and/or secondary ions. Critical angles for channeling, relative reductions in yield and transparency ratios were calculated from the data. The experimental results were compared with predictions of the Onterdelinden (Can. J. Phys.; 46: 739 (1968)) and transparency models of sputtering. (auth)

27639 BACKSCATTERING ENERGY LOSS PARAMETER MEASUREMENTS IN THIN METAL FILMS. Linker, G.; Meyer, O.; Gettings, M. (Kernforschungszentrum, Karlsruhe, Ger.). Thin Solid Films; 19: No. 2, 177-185(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

The back-scattering energy loss parameter [S] was determined directly from evaporated metal layers of Ti, V, Ni, Mo and Ta for 2.0 MeV He^+ ions and a back-scattering angle $\theta = 168$. Reasonable agreement was found with [S] values calculated from experimental dE/dx results tabulated by Ziegler and Chu. Discrepancies in [S] values occurred for thin Mo and Ta layers (<500 Å) and for Ti and V layers evaporated in a poor vacuum. Variations are thought to be due to film growth effects and impurity incorporation during deposition. A correlation of [S] values with layer superconducting properties was observed. (auth)

27640 CALCULATIONS OF RECOILS OF ELASTICALLY SCATTERED ^{4}He PROJECTILES. Ziegler, J. F. (IBM Watson Research Center, Yorktown Heights, NY). Thin Solid Films; 19: No. 2, 289-290(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

A table is presented to facilitate the identification of contamination which is a problem in the use of nuclear backscattering for the analysis of surface structure in solids. In the table the final energy of an elastically scattered ^{4}He projectile is equated to all stable elements. This permits any contamination to be identified if it lies on the target surface. The table is for an incident energy of 1000 keV and angles of 90 to 170°. (JFP)

27641 CALCULATIONS OF ELASTIC SCATTERING OF ^{4}He PROJECTILES FROM THIN LAYERS. Ziegler, J. F.; Lever, R. F. (IBM Watson Research Center, Yorktown Heights, NY). Thin Solid Films; 19: No. 2, 291-296(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

A table was prepared to facilitate the measurements for thin films using nuclear backscattering. The table shows, for a given number of incoming ^{4}He projectiles, how many will be scattered into a given solid angle from a given thin film. Specifically, for 1 μC of ^{4}He projectiles incident at some energy E_0 = (1000 keV) onto a uniform thin film of 10^{18} at om/cm^2, the calculation shows how many will backscatter (90 to 170°) onto a solid angle of 1 msterad. (JFP)

27642 TECHNIQUE FOR ACCURATELY MEASURING STOPPING CROSS SECTIONS OF REACTIVE METALS BY ION BACKSCATTERING: He IONS IN ERBIUM. Langley, R. A.; Biewer, R. S. (Sandia Labs., Albuquerque, NM). Thin Solid Films; 19: No. 2, 187-194(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

Measurements of the absolute stopping cross sections of reactive metals were made by ion back-scattering using in situ film deposition. The success of the method rests on the dual features of an absence of impurities in the film (particularly oxygen) and the measurement of the target areal density to a high degree of accuracy in the vacuum. Contamination was minimized by vacuum depositing the reactive metal onto the target substrate in an ultra-high vacuum chamber attached to the beam line of a 2.5 MeV Van de Graaff accelerator. In addition, two independent quartz microbalances built into the substrate holder provided accurate measurements of the film areal density. Using this technique, the

stopping cross sections for helium ions in erbium were determined from 250 keV to 2.5 MeV; these cross sections were used to determine the parameters for the analytic expression for the electronic stopping cross section formula developed by D. K. Brice. The values of the parameters are: Z = 2.997, a = 0.3197 and n = 3.168. (auth)

27643 RELATIVE MEASUREMENTS OF STOPPING CROSS SECTION FACTORS BY BACKSCATTERING. Feng, J. S. Y.; Chu, W. K.; Nicolet, M. A.; Mayer, J. W. (California Inst. of Tech., Pasadena). Thin Solid Films; 19: No. 2, 195-204(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

A procedure for evaluating relative stopping cross section factors from the ratios of two heights in a single back-scattering spectrum is described. The method, which requires a two-layered target, is used to test the stopping cross sections of 1 to 2 MeV $^4He^+$ ions incident on Au, Ag, Cu, Si and Al. The ratios of the heights of Au, Ag and Cu are consistent with published stopping cross section data. The Au–Al height ratio is within the errors quoted for the Au and Al stopping cross section measurements. The Al–Si height ratio differs significantly from the expected value. It is also shown that the height ratio changes slightly as a function of the thickness of the surface layer. (auth)

27644 RUTHERFORD BACKSCATTERING AS A TOOL TO DETERMINE ELECTRONIC STOPPING POWERS IN SOLIDS. Behrisch, R.; Scherzer, B. M. U. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Thin Solid Films; 19: No. 2, 247-257(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

Absolute measurements of the energy distributions of energetic light ions backscattered from solids can be used to determine the electronic stopping power of these ions in the solid. Stopping powers of protons (50 to 150 keV) in different metals and metal oxides (Nb, Ta, Ta_2O_5) were measured by this method. The results depend strongly on the cleanliness of the surface region. The experiments show deviations from the additive rule for the stopping power in compounds in this energy range. (auth)

27645 GENERAL FEATURES OF RANDOM ELASTIC-SCATTERING SPECTRA. Jack, H. E. Jr. (Kansas State Univ., Manhattan). Thin Solid Films; 19: No. 2, 267-279(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

The dependence of the yields and the shapes of the energy distribution spectra generated by projectiles elastically scattered from smooth-surfaced random solid target materials on the stopping power of the material, on the scattering cross section and on the geometry of the experimental arrangement is computationally investigated. The effects of such secondary phenomena as straggling, angular beam divergence and loss of beam intensity with increasing penetration depth are neglected. General arguments demonstrate that these spectra are quite sensitive to the energy dependence of both the stopping power and the cross section, but to different extents depending on the geometry of the experimental arrangement. If the arrangement is such that the observed projectiles must travel a much larger path length to leave the target material after scattering than they travel to reach the scattering site, then the stopping power plays the dominant role in shaping the spectrum. Specifically, the spectrum tends to follow strongly the shape of the reciprocal of the stopping power versus energy curve. When the arrangement is such that these path lengths have the opposite relation, then the cross section comes into strong competition with the stopping power in shaping the spectrum. These features are illustrated by the spectra calculated using two model stopping powers and simple power-law cross sections. One model assigns simple power-law energy dependence to the stopping power, while the other model assigns an energy dependence which approaches $E^{\frac{1}{2}}$ at low energies and $E^{-1} \times \ln E$ at high energies. (auth)

Atomic and Molecular Properties

Refer also to abstracts 28272 and 28887.

27646 (COO-3272-34) SPECTRA OF RARE EARTH IONS AND HYDROGEN MOLECULES. Final Report, November 1, 1952–October 31, 1971. Crosswhite, H. M. (Johns Hopkins Univ., Baltimore, Md. (USA)). 1971. Contract AT(30-1)-1447. 15p. Dep. NTIS $4.00.

Research on the experimental spectrum analysis of the isotopic hydrogen molecules, experimental level analysis of rare earth ions in crystals, and the development of the theory of atomic structure of complex atoms is summarized. This research covers the spectra of molecular hydrogen and its isotopes, rare earth crystal spectra, theoretical spectroscopy, and rare earth and uranium free ion spectra. A list of publications is included. (JFP)

27647 (LA-UR-74-27) EXTENDED HUECKEL β PARAMETERS APPLIED TO DIATOMIC MOLECULES. Engelke, S. Z. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 19p. (CONF-740110-1). Dep. NTIS $3.00.

From international symposium on atomic, molecular, solid-state theory, and quantum statistics; Sanibel Island, Florida, USA (20 Jan 1974).

Atom-atom separations predicted by extended Hückel theory using four β parameter approximations are compared for 15 diatomic molecules. Equilibrium separations R_e determined from a new proposed formula for the β parameter are compared with R_e's resulting from the Mulliken-Wolfsberg-Helmholtz, Cusachs, and Jug β formulas. Results show that the new β formula is best in its prediction of R_e's. The new formula has the required property of yielding rotationally invariant results. (auth)

27648 (ORNL-TM-4426) TOPICAL CONFERENCE ON ATOMIC AND MOLECULAR STUDIES AT ORNL, OAK RIDGE, TENNESSEE, MARCH 22–23, 1973. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 156p. (CONF-730351-). Dep. NTIS $10.00.

Summaries are presented on thirty-three ORNL projects in experimental and theoretical atomic and molecular studies. Seventeen of these papers were selected for inclusion in NSA. (SFL)

For abstracts of individual papers see: 26656, 27305, 27370, 27633, 27634, 27649–27651, 27686–27693, and 28090.

27649 (ORNL-TM-4426, pp 1-7) ELECTRON SPECTROSCOPY. Carlson, T. A. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22-23, 1973.

Research in electron spectroscopy is summarized. This research has the goal of high resolution measurements of the energy spectra of ejected electrons, used principally to establish the binding energies of the atomic and molecular orbitals. The research effort in uv photoelectron spectroscopy is aimed at obtaining the energy level scheme for gaseous molecules. (JFP)

27650 (ORNL-TM-4426, pp 86-88) NON-BORN–OPPENHEIMER CALCULATIONS. Thomas, I. L. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22-23, 1973.

Solutions to the Schroedinger equation are obtained without the use of the Born–Oppenheimer approximation. The ground states of H_2^+, HD^+, and HT^+ are found, and the protonic energy levels of CH_4, NH_3, and H_2O are calculated in Hartrees. (JFP)

27651 (ORNL-TM-4426, pp 92-103) ATOMIC SPECTROSCOPY. Vander Sluis, K. L. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22-23, 1973.

Studies are made of the involvement of f electrons either in the lanthanide or the actinide series of elements. These include computer routines for the wavelength description of Gd. (JFP)

27652 EXACT SEMICLASSICAL SOLUTION FOR THE TIME EVOLUTION OF A QUANTUM-MECHANICAL SYSTEM IN A CIRCULARLY POLARIZED MONOCHROMATIC DRIVING FIELD. Salzman, W. R. (Univ. of Arizona, Tucson). Chem. Phys. Lett.; 25: No. 2, 302-304(15 Mar 1974).

A closed-form exact solution is presented for the time evolution operator of a nonrelativistic hydrogen atom driven by a circularly polarized monochromatic light beam. The solution has the form $U(t,0) = \exp(-itF)\exp(-itG)$, where F and G are time independent operators. All temporal effects of the oscillating field are included. Extension to other systems is easily made. A generalization of the rotating wave approximation to multilevel systems is also presented. (auth)

27653 COMPARISON OF SINGLY EXCITED AND PAIR-EXCITED MULTICONFIGURATION WAVE FUNCTIONS FOR THE GROUND STATES OF THE ATOMS He TO F. Grein, F.; Banerjee, A. (Univ. of New Brunswick, Canada). Chem. Phys. Lett.; 25: No. 2, 255-258(15 Mar 1974).

ASE wave functions containing singly excited (SE) configurations for each space orbital of the principal configuration are compared with similarly constructed pair-excitation (PE) wave

functions. The energies are exactly or almost the same. Near-redundant configurations are removed, and the equivalence of SE with PE wave functions is investigated for special cases. (auth)

27654 VIBRATIONAL RELAXATION OF H_2 IN THE RANGE 500 TO 40°K. Audibert, M. M.; Joffrin, C.; Ducuing, J. (Paris Univ., Orsay, France). Chem. Phys. Lett.; 25: No. 2, 158-163 (15 Mar 1974).

The vibrational relaxation of n-H_2 was studied in the interval 500 to 40°K. The results show a marked departure from the high temperature Landau–Teller behavior: the deexcitation rate becomes approximately constant for the lowest investigated temperatures. The experimental observations are discussed in terms of the threshold theorems, the influence of the attractive potential and the possible occurrence of collision and bound dimers. (auth)

27655 COMPOSITE PARTICLES IN MANY-BODY SYSTEMS. Sakakura, A. Y. (Colorado School of Mines, Golden). Lect. Theor. Phys.; 14B: 483-510(1973).

A second quantization formalism for composite particles in many-body systems is presented. The hydrogen atom is considered. (JFP)

27656 LASER INDUCED PHOTODISSOCIATION OF H_2^+ IONS. Van Asselt, N. P. F. B.; Maas, J. G.; Los, J. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Chem. Phys. Lett.; 24: No. 4, 555-558(15 Feb 1974).

The momentum spectrum of H^+ ions obtained by photodissociation of a H_2^+ beam with a laser was measured. The relative distribution over several vibrational levels in the primary beam is calculated. (auth)

27657 CALCULATION OF THE ENERGY OF HYDROGEN MOLECULES BY MEANS OF WAVE FUNCTIONS OF THE MOTION OF AN ELECTRON IN THE FIELD OF TWO IMMOBLE NUCLEI. Kapyshev, V. K. Zh. Strukt. Khim.; 14: No. 5, 875-878(1973). (In Russian).

The energy of hydrogen molecules was calculated for immobile nuclei at R = 1.4 a.u. For construction of the Heitler-London functions wave functions were used which are a precise solution of problems on the motion of electrons in the field of immobile nuclei $[-\nabla^2 - \alpha(2.z_a/\nu_a) - \beta(2.z_b/\nu_b)]\,\psi = E\,\psi$. Screening of the nuclear charge by electrons was taken into consideration by use of the α and β coefficients. The minimum value of the energy of the H_2 molecule is attained at α = 1.1 and β = 0.3 and equals E = −2.301 rydberg. (tr-auth)

27658 MINIMUM EFFECTIVE RADIUS OF ATOMS OF ELEMENTS OF THE VII PRINCIPAL GROUP OF THE PERIODIC SYSTEM. Georgiev, G. I.; Genchev, M. S. Zh. Strukt. Khim.; 14: No. 5, 950-952(1973). (In Russian).

The minimum effect radii of HeI, NeI, ArI, KrI, and XeI were calculated from published experimental data. (JSR)

27659 VARIATIONAL CALCULATION OF THE LONG-RANGE INTERACTION BETWEEN TWO GROUND-STATE HYDROGEN ATOMS. Kolos, W. (Max-Planck Inst. for Physics and Astrophysics, Munich); Wolniewicz, L. Chem. Phys. Lett.; 24: No. 4, 457-460(15 Feb 1974).

Potential energy curves for the ground state $X^1\Sigma_g^+$ and for the $b^3\Sigma_u^+$ state of the hydrogen molecule were calculated for internuclear distances $6 \le R \le 12$ au. The wave functions were represented by 60-term expansions in elliptic coordinates including the interelectronic distance. Improvement over previous results was obtained. The computed energies are analyzed from the point of view of the theory of long-range interactions. (auth)

27660 NONADIABATIC CORRECTIONS TO THE VIBRATIONAL ENERGIES OF THE HYDROGEN MOLECULE. Orlikowski, T.; Wolniewicz, L. (Copernicus Univ., Torun, Poland). Chem. Phys. Lett.; 24: No. 4, 461-463(15 Feb 1974).

The nonadiabatic corrections to the vibrational levels of H_2 and D_2 are evaluated for the $X^1\Sigma_g^+$ state by taking into account the coupling with the E, $F^1\Sigma_g^+$ electronic state. The computed corrections diminish the existing discrepancy between the experimental and theoretical vibrational quanta by about 20%. (auth)

27661 POTENTIAL ENERGY SURFACE FOR THE HYDROGEN MOLECULE: HELIUM SYSTEM. Wilson, C. W. Jr.; Kapral, R.; Burns, G. (Univ. of Toronto). Chem. Phys. Lett.; 24: No. 4, 488-491(15 Feb 1974).

The results of an ab initio calculation of the potential energy surface governing atomic hydrogen recombination in the presence of helium atoms are presented. (auth)

27662 MEASUREMENT OF THE WEAK HYPERFINE STRUCTURE OF THE $^3P_1$ LEVEL OF ^{3}He FROM OBSERVATIONS OF A SIGNAL ARISING FROM AN ELECTRON ALIGNMENT AND A NUCLEAR ORIENTATION. Stoeckel, F.; Lombardi, M. (Univ., Grenoble, France). J. Phys. (Paris); 34: No. 11, 951-959(Nov 1973). (In French).

A method is presented for the determination of weak hyperfine structure interaction constants (a $\tau < 1$). Signals arising from the interaction between an electronic alignment created in the level under consideration and a nuclear orientation are detected. A theoretical study effected for the J = 1, I = ½ level is presented. The experiment was conducted on the 3^1P_1 level of ^{3}He. A value of a = + 1.06 ± 0.25 MHz was determined. (auth)

27663 STUDY OF OPTICAL PUMPING BY METASTABILITY EXCHANGE IN ^{3}He. Part 2. Dupont-Roc, J.; Leduc, M.; Laloe, F. (Ecole Normale Superieure, Paris). J. Phys. (Paris); 34: No. 11, 977-987(Nov 1973). (In French).

Magnetic resonance experiments with ^{3}He atoms subjected to indirect optical pumping by the intermediate of the metastable 2^3S_1 level are discussed. The resonance characteristics of the ground level and the two hyperfine sub-levels of metastable 2^3S_1 are calculated. Results previously obtained on metastability exchange collisions are used for this purpose. These results introduce strong coupling between the orientations of the different levels studied. Experiments carried out to verify certain aspects of the previous theory (widths, intensities and positions of the magnetic resonance curves observed for the ground and metastable states) are reviewed. (auth)

27664 STUDY OF OPTICAL PUMPING BY METASTABILITY EXCHANGE IN ^{3}He. Part I. Dupont-Roc, J.; Leduc, M.; Laloe, F. (Ecole Normale Superieure, Paris). J. Phys. (Paris); 34: No. 11, 961-976(Nov 1973). (In French).

Theoretical investigations are presented on the effect of metastability exchange collisions on the internal variables of atoms in the 1^1S_0 ground state and the 2^3S_1 metastable state. The method adopted involves the direct use of the equations describing the behavior of the orientation and the alignment of the different levels. A detailed, but relatively simple, description is obtained in this way for the indirect optical pumping mechanism for ^{3}He. Studies of the coupling between the longitudinal orientations of the different levels enabled an explanation to be provided for the pumping kinetics, in particular the building-up time for the nuclear orientation in the ground level. Detailed calculations were effected on coherence circulation effects which can manifest themselves as shifts in the resonant frequencies of the different levels associated with the transverse orientations. (auth)

27665 LIGHT-SHIFTS CAUSED BY A CO_2 LASER ON HYDROGEN ATOMS: INFLUENCE OF THE HIGHLY EXCITED BOUND AND FREE STATES. Dubreuil, B.; Chapelle, J. (CNRS, Orlean-Cedex, France). Phys. Lett.; 46A: No. 7, 451-452(11 Feb 1974).

The values of the light-shifts of a hydrogen atom in a strong radiation field were calculated including interactions with highly excited bound and free states. Neglecting these contributions may lead to relatively large errors. (auth)

27666 DISCRETE-CONTINUOUS HYDROGENIC r^k INTEGRALS BY A LADDER-OPERATOR PROCEDURE. Hadinger, G.; Bessis, N.; Bessis, G. (Univ., Lyon, Villeurbanne, France). Phys. Rev., A; 8: No. 6, 2781-2784(Dec 1973).

It is shown that the "accelerated" or "multistep" ladder-operator procedure, when introducing pseudo-key matrix elements, leads to a closed-form expressions for the discrete-continuous hydrogenic r^k matrix elements. (auth)

27667 POSSIBILITY OF STUDYING AUTOIONIZING STATES OF ATOMS BY THE COINCIDENCE METHOD. Balashov, V. V.; Lipovetskii, S. S.; Senashenko, V. S. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 4, 503-505(1973). (In Russian).

The basic regularities in the behavior of the intensity and profiles of resonance lines were examined as a function of the choice of the kinematic scheme of the coincidence method for study of the optically permitted and optically forbidden autoionizing states. Calculations were made for the (2s2p) $^1P^-$ and $(2s^2)$ $^1S^+$ states of the helium atom. (2 graphs) (JSR)

27668 HYDROGENIC ATOM MULTIPHOTON IONIZATION BY INTENSE FIELDS WITH GREEN'S METHOD. Mbounga, J. M.; Rachman, A. (Faculte des Sciences, Poiters, France). Phys. Lett.; 47A: No. 2, 113-114(11 Mar 1974).

An expression for n-photon cross section ionization of hydrogenic atoms by intense linearly polarized light is obtained using the second quantification formalism for the radiation and the Green's function method. It is shown that it reduces into Stobbe's formula in the one photon case. (auth)

27669 ATOMIC IONIZATION BY ULTRA-STRONG LASER FIELDS. Mittleman, M. H. (City Coll., New York). Phys. Lett.; 47A: No. 1, 55-56(25 Feb 1974).

The problem of multi-photon ionization of hydrogen by ultra-strong electromagnetic fields is solved in the limit where the field energy is greater than the Coulomb energy. The transition rate goes to zero as the reciprocal of the field strength. (auth)

27670 PHOTOELECTRON SPECTROSCOPY OF MOLECULES. Conference Held at Brighton, England, September 14–16, 1972. Faraday Discussions of the Chemical Society, No. 54. London; Chemical Society (1973). 309p. (CONF-720909-). £ 5.00.

The conference on molecular spectroscopy includes ionization, core binding energies, orbital methods, transient species, free radicals, bonding studies, autoionization, ultraviolet data on valence shells, semiempirical SCF Mo calculations, resonance steric inhibition, x-ray induced spectra, high energy spectroscopy, gas phase molecular core and valence levels, and angular distribution studies. (JFP)

27671 MOLECULAR PHYSICS. Second Edition. Part A. Williams, D. (ed.). Methods of Experimental Physics. Volume 3. New York; Academic Press Inc. (1974). 492p. $29.50.

The topics discussed include microwave spectroscopy, infrared, electronic spectroscopy, molecular lasing systems, spontaneous Rayleigh, Brillouin, and Raman scattering, stimulated scattering, and stimulated Brillouin and Raman scattering. (JFP)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 27866 and 28551.

27672 POSITRON ANNIHILATION IN AMINO ACIDS. Dezsi, I.; Horvath, D.; Kajcsos, Z. (Central Research Inst. for Physics, Budapest). Chem. Phys. Lett.; 24: No. 4, 514-515(15 Feb 1974).

Positron lifetime measurements were performed on eight different amino acids. τ_1, τ_2 and I_2 values were observed at around 0.35 nsec, 0.7 to 1.2 nsec and 20 to 30%, respectively. The long-lived component seems to be produced by positronium states trapped in the crystalline lattice or by positronium atoms bound to molecules. (auth)

27673 EFFECT OF ELECTRON DENSITY ANISOTROPY ON POSITRON ANNIHILATION IN A KBr SINGLE CRYSTAL. Arefiev, K. P.; Vorobiev, S. A. (Tomsk Polytechnical Inst., USSR). Krist. Tech.; No. 7, 841-844(1972).

The use of the positron annihilation method in the study of electron states in oriented single crystals was investigated. Electron density distributions and the values of the anion effective charges were measured in ⟨100⟩ and ⟨110⟩ directions of KBr single crystals showing marked distinction. (auth)

27674 ANNIHILATION RATE AND THE TWO γ-RAY ANGULAR CORRELATION PRODUCED BY AN ELECTRON POSITRON PAIR IN AN e^+–H SYSTEM. Wakid, S. E. A. (Haigazian Coll., Beirut). Phys. Lett.; 46A: No. 7, 493-494(11 Feb 1974).

Using a wave function, previously developed for a positron-hydrogen atom scattering and which exhibits the best, so far, bound; the above two experimentally measurable parameters are evaluated for energies up to the positronium threshold. (auth)

27675 POSITRONS IN FIELDS OF NEGATIVE IONS. Gataullin, R. M. (Inst. of Electronics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 5, 73-74(1973). (In Russian).

Positron-containing systems are calculated by means of the improved algorithm of the self-consistent field method. Positrons are examined in fields of negative H^-, He^-, and Li^- ions and neutral He and Li atoms with consideration of the effect of positrons on the electrons of the atomic system. The lifetimes of these systems are calculated. (JSR)

27676 SOLVING THE BETHE–GOLDSTONE EQUATION FOR A POSITRON IN AN ELECTRON GAS. Stachowiak, H.; Szotek, Z. (Inst. of Low Temperature and Structure Research, Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 21: No. 11, 1011-1019(1973).

It is shown that the use of the ES potential, which has very convenient mathematical properties, allows one to solve the Bethe–Goldstone equation for a positron in an electron gas in a period 8 times shorter than when using the static RPA potential, with no essential change in the results. (auth)

27677 APPLICATION OF THE MOBILE RPA POTENTIAL IN THE BETHE–GOLDSTONE EQUATION FOR A POSITRON IN AN ELECTRON GAS. Szotek, Z. (Inst. of Low Temperature and Structure Research, Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 21: No. 11, 1021-1025(1973).

The mobile RPA potential is used in the Bethe–Goldstone equation for a positron in an electron gas. The appropriate enhancement factors and the annihilation rates obtained in this way are close to those found by Kahana for $r_s \leq 3$ and experimentally by Weisberg. So, the shape of the potential assumed in the Bethe–Goldstone equation is not very important at high electron densities. (auth)

27678 POSITRON ANNIHILATION FROM EXCITED STATES OF $[X^-e^+]$ SYSTEMS. Cade, P. E.; Farazdel, A. (Univ. of Massachusetts, Amherst). Phys. Lett.; 47A: No. 2, 179-180 (11 Mar 1974).

The relative probabilities for the radiative de-excitation $2p_+ \rightarrow 1s_+$ versus 2γ-annihilation for the $\ldots ns^1np^6 2p_+$, ^2P state of the $[X^-e^+]$ system with X = F, Cl, Br, and I are presented. It is shown that a positron captured into a $2p_+$ orbital undergoes annihilation with electrons of the system instead of radiative transition to the ground state of the $[X^-e^+]$ system. (auth)

Collision Phenomena

Refer also to abstracts 28077, 28465, and 28498.

27679 (CEA-N-1663) DETERMINATION OF THE IONIZATION CROSS SECTIONS OF LONG-LIVED EXCITED HELIUM, NEON, AND ARGON ATOMS BY ELECTRON BOMBARDMENT. Shearer, W. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Recherche et Analyse). Oct 1973. 134p. (In French). Dep. NTIS (U. S. Sales Only) $9.75.

Thesis. Submitted to Paris Univ., Orsay, France.

An atomic beam crossed by two electron beams was used to measure the ionization cross section of long-lifetime excited helium, neon and argon atoms by electron bombardment. The results obtained concern both ionization from metastable states and ionization from excited Rydberg states. These results were obtained for ionizing electron energies of between 3 eV and 2 eV below the ionization potential of the ground-state atoms. The shapes of the curves obtained for the ionization cross sections of metastable states of these three gases are in good agreement with those obtained by Fite and Brackmann and those calculated using the Grysinski theory. The results demonstrate that a beam of metastable atoms produced by bombardment with electrons having energies similar or superior to the ground-state ionization potential of these atoms can contain a small proportion of atoms excited to the Rydberg state. The effect of such atoms becomes very important when the beam is to be used for experiments involving collisions between metastable atoms and other particles. (auth)

27680 (COO-3427-6, pp 28-31) FINAL VALUES OF CAPTURE–LOSS CROSS SECTIONS OF ^{10}B, ^{11}B, AND ^{12}C IONS IN BORON AND CARBON. 1973.

In nuclear chemistry research.

27681 (FRNC-R-21) ATOMIC PHYSICS CENTER IN 1972. Progress Report. Blanc, D. (Toulouse-3 Univ., 31 (France). Centre de Physique Atomique et Nucleaire). 1972. 115p. (In French). Dep. NTIS (U.S. Sales Only) $7.75.

The activities of the Toulouse Atomic Physics Center in 1972 are presented. Each research group of the atomic physics section is dealt with separately: atomic collisions, afterglow in gases, dc discharges in medium and high pressure gases, electric arcs, the physics of dielectrics, transport of radiation in matter, stimulated electronic emission, and pn semiconductor junctions. Because of its size, the aerosol and atmospheric exchanges section was not divided into different research groups; the work carried out by this section is presented as a single overall account. (auth)

27682 (INIS-mf-1002) RADIATIVE DECAY AND PREDISSOCIATION OF EXCITED STATES IN N_2^+. van de Runstraat, C. A. (Amsterdam Univ. (Netherlands)). 1973. 95p. INIS.

An experimental study is made of two vibrational excited states of the nitrogen molecular ion. The deexcitation by means of photon emission and the fragmentation by means of predissociation are investigated. The role of the N_2^+ $C\,^2\Sigma_u^+$ state which can decay by both mechanisms is dominant. The momentum distribution of N^+ fragments is studied utilizing a mass spectrometer. These values support the interpretation of the two types of fragment energy distributions obtained. Besides the fragments also light emissions from a metastable N_2^+ beam are investigated. It is not possible to find a relation with the determined energy levels of the predissociating metastables. However, a large part of the spectrum between 4800 and 6000 Å can be identified as an extension of the

known Meinel band system in N_2^+. In addition to qualitative results on the C-state predissociation mentioned, the ratio of probabilities for radiation and fragmentation is determined quantitatively for the levels v = 3-8. In the analysis of optical experiments a comparison is made between measured and calculated emission distributions. The discrepancies between the two are interpreted to be due to predissociation. The measured distribution is within the limits of error the same for 90-eV electron and fast ($\sim 10^8$ cm s^{-1}) He^+ impact on nitrogen. The calculation is a Franck–Condon type excitation modified for configuration interaction. The probability for predissociation increases with increasing vibrational quantum number and supersedes that for the radiation by a factor 10 to 100. A remarkable large isotope effect is found: all levels of $^{15}N^{15}N^+$ predissociate about a factor 10 slower than those of $^{14}N^{14}N^+$ and the $^{15}N^{15}N^+$ levels about a factor 6 slower. This result is important in the analysis of the mechanism responsible for the dissociation process. Special attention is drawn to a so-called "accidental predissociation". (auth)

27683 (LA-5409) KINETICS OF AN H_2-F_2 EXPLOSION AS INITIATED BY A PULSE OF FLUORINE ATOMS. Sullivan, J. H.; Feber, R. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. 28p. Dep. NTIS $4.00.

The elementary reactions occurring in an H_2-F_2 explosion are given with each vibrational level of H_2 and HF considered as a separate reacting species. Rate coefficients for all the elementary reactions are either estimated or calculated, and the major assumptions entering into the determination of each rate coefficient are given. The effect of non-Maxwell distributions in the translational energies of some of the species is estimated. For strong pulses of F atoms, the explosion is complete before any appreciable contribution to the rate is made by thermal dissociation of F_2 or H_2. (auth)

27684 (LA-5504-MS) MULTIPLE SCATTERING ENHANCEMENT OF X RAYS. Bennett, E. W. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 15p. Dep. NTIS $4.00.

A Monte Carlo calculation is described for the determination of the contribution of multiple scattering to x rays scattered at 90° in various thicknesses of beryllium and carbon plates. The plates are inclined at an angle of 45° to the incident radiation. The photon energy range considered is 1 keV to 100 keV. Scatterer thicknesses range from 0.0046 g/cm² to 1.204 g/cm². Two sets of results are given: one from a formulation neglecting the polarization, the other including polarization. Results are presented in the form of an enhancement factor defined as the ratio of the number of scattered photons escaping from the scatterer at 90° to the number escaping at 90° after scattering only once. Enhancement factors are given in both tabular and graphical form. (auth)

27685 (LBL-2346) LECTURES ON HEAVY-ION IN-BEAM SPECTROSCOPY. Diamond, R. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1973. Contract W-7405-eng-48. 126p. Dep. NTIS $9.50.

The topics of heavy-ion in-beam spectroscopy cover two results of the large angular momentum transfer with heavy ions and Coulomb excitation. (JFP)

27686 (ORNL-TM-4426, pp 11-12) IONIZING COLLISIONS OF FAST HEAVY IONS. Datz, S.; Biggerstaff, J. A.; Moak, C. D.; Appleton, B. R. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22-23, 1973.

Interactions of 15- to 60-MeV ^{127}I ions with solid and gaseous media were extensively studied with a view of elucidating the nature of the collisions in the media and the states of the penetrating ion. These studies include charge changing collisions, charge equilibria, x-ray generation, and electron production. (JFP)

27687 (ORNL-TM-4426, pp 13-19) ELECTRON SPECTRA. Sellin, I. A. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22-23, 1973.

The atomic structure of highly stripped heavy ions and their modes of formation in collisions are studied. Oxygen, chlorine, and argon ions are studied. (JFP)

27688 (ORNL-TM-4426, pp 20-28) CHARGED PARTICLE INDUCED IONIZATION CROSS SECTIONS. Duggan, J. L. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22-23, 1973.

Thin target K-shell ionization cross sections were measured for Ca, Sc, Ti, Cr, Mn, Zn, As, Se, Sn, and Sb for incident protons in the energy range from 1 to 6 MeV and alpha particles from 1 to 12 MeV. Cross sections were also measured for incident oxygen ions in the energy range from 8 to 30 MeV for Mn, Ni, Cu, Zn, Ge, and Sn. (JFP)

27689 (ORNL-TM-4426, pp 50-54) DISSOCIATIVE IONIZATION. Stockdale, J. A. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22-23, 1973.

An energy distribution obtained from a time-of-flight measurement for O^+ ions produced by impact of 50-eV electrons on O_2 and angular distribution of the ion energy groups are shown. These results shed light on the dissociating states of the O^+ ion and also are important to the radiation chemistry of O_2. (JFP)

27690 (ORNL-TM-4426, pp 62-64) ELECTRON SCATTERING AND BINDING BY MOLECULES. Garrett, W. R. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22-23, 1973.

An extensive theoretical investigation is made of electron scattering and negative ion formation by strongly polar molecules. Previous work on critical binding is extended to the case of a molecular type system which has a rotational quantum number and moment of inertia. The total scattering and momentum transfer cross sections are discussed. (JFP)

27691 (ORNL-TM-4426, pp 76-79) ATOMIC AND MOLECULAR CROSS SECTION MEASUREMENTS IN THE THERMONUCLEAR DIVISION. Barnett, C. F. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22-23, 1973.

The differential scattering cross sections for 0.5 to 4 keV D atoms in the scattering region 0 to 9° in nitrogen gas are shown. Also the cross section for the formation of H^- or D^- from the collisional dissociation of H_2^+, H_3^+, HD_2^+, in hydrogen gas was measured in the energy range from 40 to 600 keV and are shown. (JFP)

27692 (ORNL-TM-4426, pp 80-85) INELASTIC AND REACTIVE COLLISIONS OF EXCITED ATOMS. Krause, H. F. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22-23, 1973.

The de-excitation of metastable mercury atoms by collisions with H_2, D_2, N_2, NO, CH_4, and Cl_2 (electronic–vibronic energy conversion) was studied in a modulated crossed beam experiment. Quenching cross sections vx initial collision energy were derived. Also photon emission at 2537 Å and in the range 3000 to 5900 Å was observed when metastable mercury atoms collide with chlorine molecules. (JFP)

27693 (ORNL-TM-4426, pp 145) THEORY OF SINGLE ELECTRON EXCITATION AND TRANSFER IN NEUTRAL ATOM–ATOM COLLISIONS. Vora, R. B.; Turner, J. E.; Compton, R. N. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22-23, 1973.

A semiclassical approach is used to calculate excitation and charge-transfer cross sections in neutral alkali atom–oxygen collisions at 10 to 10,000 eV. The effects of the simultaneous existence of two final states on the charge-transfer and excitation cross sections are studied. (JFP)

27694 CHARGE EXCHANGE REACTIONS OF O_2^+ IONS WITH NOBLE GASES AT 2800 eV. Thean, J. E.; Johnsen, R. H. (Florida State Univ., Tallahassee). J. Mass Spectrom. Ion Phys.; 13: No. 1, 71-75(Jan 1974).

Charge exchange cross sections for O_2^+ in the $^2\Pi_g$ and $^4\Pi_u$ states with the noble gases were measured using a modified time-of-flight mass spectrometer. The ground state ion appears to charge exchange to produce the ground state molecule ($^3\Sigma_g^-$) while the excited ion appears to yield the lowest excited state of the molecule ($^1\Delta_g$). With the exception of the reaction of the $^4\Pi_u$ state of O_2^+ with

xenon, the product ions all appear to be formed in the lowest state ($^2P_{\frac{1}{2}}$). (auth)

27695 NEW CHANNEL FOR DISSOCIATIVE IONIZATION OF H_2. Hazi, A. U. (Univ. of California, Los Angeles). Chem. Phys. Lett.; 25: No. 2, 259-262(15 Mar 1974).

A new indirect mechanism is proposed for the formation of fast protons which are observed in the dissociative ionization of H_2 at electron impact energies below 29 eV. The process involves the excitation of the molecule to doubly-excited states which autoionize to the dissociative continuum of the ground $1s\sigma_g$ state of H_2^+. (auth)

27696 INVERSION OF MOLECULAR RATE DATA WITH EFFECTIVE OPTICAL POTENTIALS: K + CH_3I REACTIONS. Roberts, R. E.; Nelson, C. L. (Univ. of Indiana, Bloomington). Chem. Phys. Lett.; 25: No. 2, 278-281(15 Mar 1974).

The possibility of inverting kinetic data through effective optical potentials is explored and developed. Using arguments based on the so-called optical model of reaction dynamics, but without actually explicitly determining the effective potential, it is possible to carry out an inversion and correlation of molecular dynamics experiments. For example, by making a single reasonable assumption concerning the general features of the effective potential, one can invert the total reaction cross section as a function of collision energy to obtain reaction probabilities as a function of both impact parameter and energy for the reactions of K with CH_3I. Although the present technique represents only a lowest order approximation to the optical inversion of molecular kinetics experiments, there is good agreement with the trajectory calculations of LaBudde et al. Furthermore, it should be possible to improve upon the method, either by a more explicit determination of the properties of the optical potential or by using a more rigorously defined effective potential for the inversion process. (auth)

27697 INELASTIC SCATTERING OF POSITIVE IONS. Doering, J. P. (Johns Hopkins Univ., Baltimore). Ber. Bunsenges. Phys. Chem.; 77: No. 8, 593-605(Aug 1973).

Inelastic scattering processes in collisions of positive ions with neutral gas atoms and molecules can be divided into three main groups: 1) inelastic scattering involving electronic transitions with subdivisions into final vibrational and rotational states of the collision products; 2) inelastic scattering involving vibration-rotation transitions without a change in electronic state with subdivisions into final rotational states; and 3) inelastic scattering via pure rotational transitions. Recent advances in experimental techniques have given a great deal of new information about almost all these processes. For 1), both inelastic scattering experiments and optical fluorescence techniques have shown that although the total cross sections for electronic transitions are remarkably uniform for a large number of systems there are wide individual variations in the details of final vibrational and rotational states produced in the charge transfer and non-charge transfer channels. For 2), it was found that vibration-rotation transitions are the most intense components of the inelastic scattering spectrum with cross sections of the order of 1 A^2 at maximum for some systems. Because of experimental difficulties, little is known about 3) at the present time. In addition to inelastic processes, superelastic processes have now been studied in detail in the laboratory, both for electronic and vibration-rotation transitions. These processes promise to provide a very interesting opportunity for investigations in the future into, for example, the metastable populations of ion beams. Unfortunately, one lacks the ability at the present time to make theoretical predictions for the behavior of any but the simplest of these processes. (GE)

27698 ELASTIC SCATTERING OF IONS. Weise, H. P. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Ber. Bunsenges. Phys. Chem.; 77: No. 8, 578-593(Aug 1973).

The value of elastic scattering experiments for the determination of interaction potentials between ions and neutral particles is discussed. After a description of typical experimental setups a short introduction to the theory of rainbow scattering is given. Several methods for the evaluation of experimental results are presented. The measured differential cross sections and the resulting potential curves are discussed for the proton-rare gas systems which were extensively studied. In some cases the experimental data can be compared with quantum chemical calculations. The system He^+-He is chosen to outline the symmetry effects observed in the differential elastic scattering cross section in the case of the symmetric rare gas ion-rare atom systems. The potential depths obtained from the experimental rainbow structures are compared with the results of quantum chemical calculations and of semiempirical estimates. Some data derived from elastic scattering of He^+ by rare-gas atoms are presented. Finally experimental results are reviewed for the elastic scattering of protons by simple molecules and of H_2^+ by Ar^- and Kr-atoms. (GE)

27699 CALCULATION OF THE CHARGE EXCHANGE OF IONS IN LOW ENERGY MULTIPLE SCATTERING PROCESSES. Bednyakov, A. A.; Tulinov, A. F. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 4, 397-406(1973). (In Russian).

The possibility of calculating the effect of ion charge exchange in multiple scattering processes by introduction of the "effective screening angle" was examined. For ion beams with known charge compositions this parameter was determined as an average weighted value of the "partial screening angle" $\chi_a^{(i)}$ characterizing the scattering of ions with different total charge i. Each of the values $\chi_a^{(i)}$ was obtained as a result of the examination of the interaction of ions in corresponding charge states with the target atoms. The results obtained agree well with available experimental data. (2 tables, 3 graphs) (tr-auth)

27700 SURFACE AND VACUUM PHYSICS INDEX. Volume 8, No. 10, 1973. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 59p.

27701 SURFACE AND VACUUM PHYSICS INDEX. Volume 8, No. 11, 1973. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Nikolaev, N. S. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 63p.

27702 EXCITATION OF MULTICHARGED IONS WITH PROTONS. Presnyakov, L. P.; Ulantsev, A. D. Kratk. Soobshch. Fiz.; No. 8, 42-46(Aug 1973). (In Russian).

Within the framework of the strong coupling method with consideration of the Coulomb repulsion of partners the cross sections for the excitation of multicharged ions with protons and other heavy charged particles are calculated. The cross sections are expressed through universal functions. Tables of the functions are given for dipole and quadrupole transitions. (tr-auth)

27703 GLAUBER-THEORY APPROACH FOR MOLECULAR VIBRATIONAL EXCITATIONS. Chang, T.N.; Poe, R.T.; Ray, P. (Department of Physics, University of California, Riverside, California 92507). Phys. Rev. Lett. 31: No. 18, 1097-1099 (29 Oct 1973).

Molecular vibrational excitations by charged-particle impact are investigated within the Glauber-theory approach. Theoretical results for electron-H_2 scattering give good agreement with experimental data. We study the physical effects responsible for the structures in the differential cross section. (auth)

27704 RADIATIVE CAPTURE AND BREMSSTRAHLUNG OF BOUND ELECTRONS INDUCED BY HEAVY IONS. Kienle, P.; Kleber, M.; Povh, B.; Diamond, R.M.; Stephens, F.S.; Grosse, E.; Maier, M.R.; Proetel, D. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. Lett. 31: No. 18, 1099-1102 (29 Oct 1973).

X rays emitted during the radiative capture of target electrons into the K shell of fast and highly stripped projectiles were observed. When using targets with strongly bound electrons, a high-energy x-ray tail was also found; this new process is a type of electron bremsstrahlung. The cross sections for both these processes can be explained quantitatively. (auth)

27705 VIBRATIONAL EXCITATION OF O_2 BY ELECTRON IMPACT ABOVE 4 eV. Wong, S.F.; Boness, M.J.W.; Schulz, G.J. (Department of Engineering and Applied Science, Mason Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. Lett. 31: No. 16, 969-972 (15 Oct 1973).

Vibrational excitation of O_2 by electrons in the energy range 4–15 eV is studied with a cross-beam double electrostatic analyzer. The differential vibrational cross sections for $\nu = 1$–4 at 25° show a bell-shaped energy dependence peaked near 9.5 eV. The observations are interpreted in terms of resonant contributions by excited states of O_2^-. There is also evidence for the resonant enhancement of electronic excitations. (auth)

27706 INTERNAL ENERGY EFFECTS ON THE REACTION OF D_3^+ WITH NH_3. Smith, D. L.; Futrell, J. H. (Univ. of Utah, Salt Lake City). Chem. Phys. Lett.; 24: No. 4, 611-616(15 Feb 1974).

The D_3^+ beam from the moderately high pressure source of a tandem mass spectrometer is reacted with NH_3 resulting in formation of NH_2D^+, NH_3^+ and NH_3D^+. The relative abundance of these products is reported as a function of the average number of D_3^+–D_2 collisions in the source. This information is used to estimate the amount of excitation energy in the D_3^+ ions. (auth)

27707 FORBIDDEN RAMAN BANDS OF SF_6: COLLISION INDUCED RAMAN SCATTERING. Holzer, W.; Ouillon, R. (CNRS, Paris). Chem. Phys. Lett.; 24: No. 4, 589-593(15 Feb 1974).

The frequencies, relative scattering cross sections and depolarizations ratios of forbidden fundamental and overtone Raman bands were measured for the first time in the gaseous state. The absolute scattering cross sections of the allowed bands of gaseous SF_6 are given as well. The characteristic density dependence of the scattering cross sections of the forbidden fundamentals is explained in terms of collision induced Raman scattering. There is evidence for frame distortion of the molecules during the collision. (auth)

27708 GENERALIZATION OF RAMAN INTENSITY EXPRESSIONS SO AS TO INCLUDE RESONANCE. Mingardi, M.; Siebrand, W. (National Research Council of Canada, Ottawa). Chem. Phys. Lett.; 24: No. 4, 492-494(15 Feb 1974).

The existing expressions for Raman intensities are extended to the resonance region. Analytical formulas are obtained in the harmonic oscillator approximation. (auth)

27709 CHEBYSHEV EXPANSIONS FOR WAVE FUNCTIONS. Sheorey, V. B. (Univ. of Windsor, Ont.). Comput. Phys. Commun.; 7: No. 1, 1-12(Jan 1974).

Chebyshev series expansion of solutions of linear differential equations which occur in atomic scattering problems is discussed. This technique is applied to obtain both the regular and the irregular radial Coulomb wave functions. The Chebyshev expansion technique is extended to evaluate linearly independent solutions for the modified Coulomb potential. It is further shown that relativistic Coulomb wave functions may also be evaluated using Chebyshev expansion techniques. An advantage of this technique is that wave functions and their derivatives can be represented to a very high accuracy in terms of only a small number of Chebyshev expansion coefficients over a wide range of values of the independent variable. Moreover, in certain cases it is possible to evaluate matrix elements involving functions so represented by using properties of Chebyshev polynomials and thus avoiding numerical integration altogether. (auth)

27710 ELECTRON IMPACT EXCITATION CROSS SECTIONS. McDowell, M. R. C. (Royal Holloway Coll., Englefield Green, Eng.); Morgan, L.; Myerscough, V. P. Comput. Phys. Commun.; 7: No. 1, 38-49(Jan 1974).

The computer program POLORB written in FORTRAN IV for the CDC 7600, CDC 6600, and ICL 1904S computers is described for the determination of total and differential cross sections for the electron impact induced $1s \rightarrow ns$ transitions in hydrogenic systems in a number of approximations. The main case is the DWPO model. (JFP)

27711 APPROXIMATIONS IN THE CALCULATION OF THE EXCHANGE AND OVERLAP CORRECTIONS IN ELECTRON CAPTURE. Vatai, E. ATOMKI (At. Kut. Intez.) Kozlem.; 15: No. 4, 225-227(1973).

The role of the closure approximation in the calculations of exchange and overlap corrections is discussed. It is shown that the validity of the closure approximation for outer electrons is not a necessary condition of neglecting them and that the application of the closure approximation does not determine the accuracy of the calculations. (auth)

27712 ANOMALOUS POLE SINGULARITIES IN ATOMIC PROCESSES. Drukarev, E. G.; Gorshkov, V. G.; Michailov, A. I.; Sherman, S. G. (Leningrad Nuclear Physics Inst.). Phys. Lett.; 46A: No. 7, 467-468(11 Feb 1974).

It is shown that the triangle graph has a pole anomalous singularity due to Coulomb interaction for atomic processes. (auth)

27713 PAIR EXCITATION OF ATOMS IN RADIATIVE COLLISIONS. Goodzenko, L. I.; Yakovlenko, S. I. (Lebedev Inst. of Physics, Moscow). Phys. Lett.; 46A: No. 7, 475-476(11 Feb 1974).

The kind of radiative collision in which two atoms are simultaneously excited by one photon is considered. The experiment on observation of this effect is proposed. (auth)

27714 EXTRACTION OF SCATTERING INFORMATION FROM FREDHOLM DETERMINANTS CALCULATED IN AN L^2 BASIS: A CHEBYSCHEV DISCRETIZATION OF THE CONTINUUM. Heller, E. J. (Harvard Univ., Cambridge, MA); Rescigno, T. N.; Reinhardt, W. P. Phys. Rev., A; 8: No. 6, 2946-2951(Dec 1973).

Using the "equivalent-quadrature" relation between diagonalization of the s-wave kinetic energy H^0 in a Laguerre-type basis and Chebyschev quadrature of the second kind, a procedure is given by which potential-scattering phase shifts may be constructed from approximations to the Fredholm determinant constructed using only square-integrable (L^2) functions. For the problem of electron-hydrogen scattering in the static approximation, highly accurate phase shifts are obtained over a continuous range of energies from a single major computational step. (auth)

27715 REFLECTION OF LIGHT IONS FROM SOLID SURFACES. Boettinger, J.; Winterbon, K. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Radiat. Eff.; 20: No. 1-2, 65-67 (1973).

The reflection of 20 to 50 keV ^{7}Be from gold and silver targets was studied experimentally and theoretically. The experiments were carried out using a radiotracer technique. Theoretical values of the reflection coefficients were derived from calculated range profiles. The study is an extension of earlier work and as found previously, agreement between theory and experiment is obtained. Reflection coefficients were also calculated for ^{1}H, ^{2}H, ^{3}H and ^{4}He incident on Nb. These calculations should apply to other heavy targets also. (auth)

27716 ALTERNATIVE METHOD FOR POTENTIAL-PARAMETER DETERMINATION FROM HIGH ENERGY ELASTIC SCATTERING. Sielanko, J.; van Dop, H.; Los, J.; Kistemaker, J. (FOM-Instituut voor Atoom-en Molecuulfysica, Amsterdam). Physica; 70: No. 3, 591-598(15 Dec 1973).

Attenuation cross sections are determined for K^+ incident on Ar as a function of the angular aperture. The angular aperture can be varied from $\approx 5.5 \times 10^{-3} - 1.5 \times 10^{-2}$ rad with discrete steps of about 5×10^{-4} rad. The measurements were performed at 800, 1000, 2000, 3000 and 4000 eV. The results of this method of potential-parameter determination are compared with those obtained from the usual energy-dependent measurements. Both methods are consistent with respect to the potential slopes. There is, however, a discrepancy between the absolute magnitudes of the $K^+ - Ar$ potentials, obtained by this method and other data. The $K^+ - Ar$ potential resulting from this method can be represented by $V(r) = 10490 \exp[-3.82\ r]$, $1.65\ \text{Å} \leq r \leq 2.39\ \text{Å}$. (auth)

27717 ELECTRON IMPACT DIFFERENTIAL AND INTEGRAL CROSS SECTIONS FOR EXCITATION OF THE n = 2 STATES OF HELIUM AT 29.2 eV, 39.2 eV AND 48.2 eV. Hall, R. I.; Jayez, G.; Mazeau, J.; Reinhardt, J.; Schermann, C. (Univ., Paris). J. Phys. (Paris); 34: No. 10, 827-843(Oct 1973). (In French).

A high resolution electron impact spectrometer using electrostatic monochromators and the cross-beam technique is described. Considerations related to its construction and use in measuring cross sections are discussed. This instrument was used to obtain absolute values for differential and integral excitation cross sections of the n = 2 manifold states of helium at 29.2 eV, 39.2 eV and 48.2 eV. The results are presented and compared with currently available theoretical calculations. (auth)

27718 CALCULATION OF THE ELECTRON IMPACT IONIZATION CROSS SECTIONS FOR THE 4d SUB-SHELL OF XENON. Chiandusso, C.; Combet Farnoux, F. (Univ., Paris). Compt. Rend., Ser. A, B; 277: No. 16, 463-466(22 Oct 1973). (In French).

Calculations of the electron impact ionization cross sections for the 4d shell of xenon made using a single electron model having a central non-Coulombian potential demonstrate the existence of a suspected maximum in the ionization threshold region. This maximum has the same origin as that observed in photoionization being due essentially to $4d \rightarrow \epsilon f$ transitions. (auth)

27719 UNITARY TRANSITION PROBABILITIES FOR ATOM-ATOMIC OSCILLATOR COLLISIONS. Liu, W. S. (Univ. of Toronto). J. Chem. Phys.; 59: No. 5, 2490-2495(1 Sep 1973).

A unitary treatment, based on the work of Cabrera, Celli, Goodman, and Manson [Surface Sci. 19, 67(1970)], of multiple quantum transition probabilities for the collision of an atom with an atomic oscillator is studied. The theory is applied to the collision of helium with a tungsten atomic oscillator and compared with both exact quantum results and semiclassical results. It is shown that multiple quantum transitions have appreciable magnitude and cannot be ignored in calculating the thermal accommodation coefficients. (auth)

27720 X-RAY TRANSITIONS IN HYDROGEN-LIKE, HELIUM-LIKE AND LITHIUM-LIKE BORON. Fortner, R. J. (Univ. of California, Livermore); Garcia, J. D.; Oona, H. Phys. Lett.; 47A: No. 2, 93-94(11 Mar 1974).

The boron K x-ray spectra produced in heavy ion collisions using gas targets are reported. The observed x-ray transitions are used, to identify the one, two and three electron series of boron. The observed x-ray transition energies are found to agree well with theoretical calculations. A relatively large number of transitions involving double K-shell vacancies are observed. These transitions represent the first observation of double K-shell vacancies produced in collisions where the inner shell

vacancies occur from electron promotion via molecular orbitals of the quasi-molecule formed during the collision. (auth)

27721 EJECTION OF SURFACE ATOMS IN SINGLE CRYSTAL SPUTTERING. Lenskjaer, T. (Neils Bohr Inst., Copenhagen); Nyholm, F.; Pedersen, S. D.; Petersen, N. B. (Oersted Inst., Copenhagen). Phys. Lett.; 47A: No. 1, 63-65(25 Feb 1974).

Angular distributions of atoms sputtered around nearest-neighbor directions are calculated within the Lehmann–Sigmund model, for isotropic and anisotropic velocity distributions of subsurface atoms. The contribution of subsurface atoms to the spot turns out to be small. (auth)

27722 X-RAY MEASUREMENTS OF BREMSSTRAHLUNG AND ELECTRON CAPTURE BY FAST POSITIVE IONS. Schnopper, H. W. (Massachusetts Inst. of Tech., Cambridge); Delvaille, J. P.; Kalata, K.; Sohval, A. R.; Abdulwahab, M.; Jones, K. W.; Wegner, H. E. Phys. Lett.; 47A: No. 1, 61-62(25 Feb 1974).

Two broad spectral features which may be easily overlooked or misinterpreted in the discussion of x-ray spectra induced by fast atomic collisions are reported. Calculations based on relatively simple models are in good agreement with the data. (auth)

Atomic Theory

Refer also to abstracts 27646 and 27849.

27723 BINARY SYSTEM OF THE CHARGED INTERACTING PARTICLES IN THE METHOD OF DISPLACEMENTS AND COLLECTIVE VARIABLES. I. Representation of Statistic Operator. Vavrukh, M. V. (Inst. of Theoretical Physics, Lvov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 12, 1966-1977(Dec 1973). (In Russian).

The work deals with statistical operator of the binary quantum system of the charged particles (electrons and ions) with the Coulomb interaction. Representation of the displacements $e^{-\beta H} = e^{\hat{U}\hat{\sigma}}$ in the secondary quantization was utilized for the statistic operator. The integral representation in the space of collective variables is realized using transition functions. An approximate spectrum of collective motions of the considered system was obtained, the low frequency branch of which is investigated in the case of densities, characteristic of the real metals. (auth)

27724 ELECTRON X-RAY ANGULAR CORRELATION. Piticu, I.; Vata, I. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 9, 1119-1124(1973).

Using the polarization tensor method the e-X angular correlation function is deduced. The $A_2(e)$ coefficients values are calculated for $73 \leq Z \leq 95$ and $0.05 \leq k \leq 0.7\ m_0c^2$. (auth)

27725 RESONANCE EXCITATION OF ATOMIC LEVELS IN A STRONG ELECTROMAGNETIC FIELD. Zaretskii, D. F.; Krinov, V. P. (Moscow Engineering-Physics Inst.). Zh. Eksp. Teor. Fiz.; 66: No. 2, 537-541(Feb 1974). (In Russian).

The interaction between a classical electromagnetic field of arbitrary intensity and a two-level atom is considered by a method which is mathematically equivalent to the quasiclassical approach to the problem of reflection at energies exceeding the barrier energy. It is assumed that the external field frequency is small compared with the distance between the atomic levels. The resonance probability for multiphoton transition in a linear regime is calculated. The Stark effect in a strong field is evaluated. The region of applicability of perturbation theory to the problem under consideration is determined. It is demonstrated that the gauge transformation method, which has been intensively employed in recent years for solution of problems of this type, is in fact invalid. (auth)

27726 CONCISE EXPRESSION FOR THE ALL-ORDER BLOCH–SIEGERT SHIFT. Swain, S. (Queen's Univ., Belfast). Phys. Lett.; 46A: No. 7, 435-436(11 Feb 1974).

A simple formula is derived which is found to describe the Bloch–Siegert shift with good accuracy over almost the whole range of field strengths. (auth)

27727 ELECTRON-NUCLEAR γ-TRANSITION OF NUCLEI IN ATOMS. Letokhov, V. S. Phys. Lett.; 46A: No. 7, 481-482 (11 Feb 1974).

The recoil effect of γ-quantum for nuclei in atoms has influence on the electron motion. As a result, the electron satellites occur in the spectrum of the γ-radiation of a nucleus in atoms. (auth)

27728 USEFUL EXTREMUM PRINCIPLE FOR THE VARIATIONAL CALCULATION OF MATRIX ELEMENTS. Gerjuoy, E. (Univ. of Pittsburgh); Rau, A. R. P.; Rosenberg, L.; Spruch, L. Phys. Rev., A; 9: No. 1, 108-117(Jan 1974).

Variational principles for the estimation of the matrix element $W_{nn} \equiv (\phi_n, W\phi_n)$ for an arbitrary operator W are of great interest. The variational estimates are constructed from a trial wave function ϕ_{nt}, an approximation to the nth normalized bound-state eigenfunction ϕ_n, and of a trial auxiliary function L_t, an approximation to L which satisfies $(H - E_n)L = (W_{nn} - W)\phi_n \equiv q(\phi_n)$. Variational-principle applications were limited by the difficulty of obtaining a reasonable L_t; among other things, one demands that L_t approach L as ϕ_{nt} approaches ϕ_n. The equation $(H - E_{nt})L_t = q(\phi_{nt})$, where $E_{nt} = (\phi_{nt}, H\phi_{nt})$, is known not to provide such an L. A practical procedure for handling complicated systems given a reasonably accurate Rayleigh-Ritz trial function ϕ_{nt} is called for. Such a procedure is provided using techniques developed in the establishment of variational bounds on scattering lengths. Given H and ϕ_{nt}, we define L_t by $AL_t = q(\phi_{nt})$, where A differs from $H - E_n$ in that the influence of states 1 through n was effectively "subtracted out"; the operator A is nonnegative. A functional $M(L_{tt})$ is constructed which is an extremum for $L_{tt} = L_t$. Variational parameters contained in L_{tt} can be determined by extremizing $M(L_{tt})$, thereby providing an approximation to L_t. The method is analogous to the determination of parameters in ϕ_{nt} by the minimization of $(\phi_{nt}, H\phi_{nt})/(\phi_{nt}, \phi_{nt})$. The method is immediately applicable to the variational determination of off-diagonal matrix elements W_{nm} and of diagonal matrix elements of normal and of modified Green's functions. (auth)

27729 VARIATIONAL SOLUTION OF SCHROEDINGER'S EQUATION FOR THE STATIC SCREENED COULOMB POTENTIAL. Roussel, K. M. (Louisiana State Univ., Baton Rouge); O'Connell, R. F. Phys. Rev., A; 9: No. 1, 52-56(Jan 1974).

A variational method is used to obtain solutions to Schrödinger's equation for a particle in a static screened Coulomb potential. Energy eigenvalues are obtained for the lowest 45 states. The analytic wave functions generated by this method are used to obtain the probabilities for spontaneous emission in the dipole approximation as a function of screening length, for transitions between the six lowest states. (auth)

27730 ALTERNATIVE BASIS FOR THE THEORY OF COMPLEX SPECTRA. Harter, W. G. (Univ. of Southern California, Los Angeles). Phys. Rev., A; 8: No. 6, 2819-2827(Dec 1973).

A new method is given for deriving the angular factors of energy matrices in l^n atomic configurations, and the need for coefficients of fractional parentage, Racah coefficients, algebraic formulas, and chain calculations is avoided. Instead, matrix elements are obtained directly by a comparatively simple digital counting procedure. (auth)

27731 BOUNDARIES TO THE NUCLEAR DIAMAGNETIC SCREENING CONSTANTS IN ATOMS AND MOLECULES. Penkina, N. N.; Rebane, T. K. Vestn. Leningrad. Univ., Fiz., Khim.; No. 3, 20-28(Aug 1973). (In Russian).

A method of calculation of upper and lower bounds to the nuclear diamagnetic screening constants in atoms and molecules was proposed. No information is required concerning electronic wave functions. The essence of the method is the scaling procedure applied to the Hamiltonians of isoelectronic systems, and the only information used concerns full electronic energies of atoms and molecules. (auth)

27732 ASYMPTOTIC BEHAVIOR OF ATOMIC BOUND STATE WAVE FUNCTIONS. Ahlrichs, R. (Univ., Karlsruhe, Ger.). J. Math. Phys. (N.Y.); 14: No. 12, 1860-1863(Dec 1973).

The asymptotic properties of an exact bound state wave function φ of an n-electron atomic system within the infinite nuclear mass approximation and neglecting relativistic effects. An explicit upper bound is derived for $||r_i^{\mu}\varphi||$, where r_i denotes the distance of the ith electron from the nucleus and $\mu = 1,2,3, \ldots$. One can then derive upper bounds for expressions like $||h(r_i)\varphi||$, where h (x) is an exponentially increasing function. Finally an exponentially decreasing pointwise bound for φ is indicated. (auth)

27733 THEORY OF EXCHANGE INTERACTIONS BETWEEN WEAKLY COUPLED OPEN-SHELL ATOMS. Block, R. (Advanced Studies Center, Geneva). Physica; 70: No. 2, 397-409 (1 Dec 1973).

Using the technique of symmetric double-coset (SDC) expansion of permutation groups, an explicit expression is obtained for the exchange interaction between two weakly coupled atoms A and B in the state of highest multiplicity, without the assumption of orthogonality between the orbitals of A and B. A simple derivation for the spin-dependent part of the interaction energy is given as the expectation value of a polynomial in the scalar product $S_A \cdot S_B$, the highest exponent being equal to the lower number of unpaired electrons of the atoms. The SDC method enables one to obtain in a straightforward and relatively simple way explicit expressions for the coefficients occurring in the polynomial. As an example, the coefficients are given in detail for the special case of three unpaired electrons on A and B. (auth)

27734 DIRECT ANALYTICAL CALCULATION OF FIRST-ORDER DENSITY MATRIX ELEMENTS THROUGH THIRD ORDER. Simons, J. (Univ. of Utah, Salt Lake City). J. Chem. Phys.; 59: No. 5, 2436-2440(1 Sep 1973).

A theory which permits the analytical calculation of atomic and molecular first-order density matrices in a computationally tractable manner is developed. Contour integral techniques are used to derive an equation relating the first-order density matrix γ to certain eigenvectors which arise in earlier theory of molecular ionization potentials and electron affinities. By analytically evaluating the resulting contour integral, one obtains a closed expression giving γ in terms of Hartree–Fock orbital energies and two-electron integrals. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstract 26776.

27735 EXACT SOLUTION OF A THREE DIMENSIONAL ELECTRODYNAMIC PROBLEM. Kapusta, A. B.; Litvinova, T. S. Magn. Gidrodin.; No. 3, 81-84(1973). (In Russian).

Electromagnetic processes are considered in an infinitely long region filled with an ideal ferromagnetic material (region ϕ). This region connects with two identical parallel cylinders of an ideal ferromagnetic material. The region with planes parallel to the boundary of region ϕ is divided into three zones arranged symmetrically with respect to the origin. Zone 2 is filled with an electrically-conducting medium, and zone 1 with a dielectric. It is assumed that at the outer boundaries of zone 1 there are synphase variable current layers. The component of the vector potential in these zones in the bicylindrical system of coordinates is described by a dimensionless equation. An automodel solution is found for the three-dimensional problem describing the propagation of a plane wave in a region possessing bicylindrical symmetry. Formulas are obtained for calculating the electromagnetic field, and local and integral forces. The results are compared with experiment. Good qualitative and quantitative agreement of theory and experiment is noted. A number of energy parameters of the system were determined. (SJR)

27736 CIRCULAR MHD FLOW IN CROSSED ELECTRICAL AND MAGNETIC FIELDS. Volkov, A. V.; Gurfink, M. M.; Poluektov, A. P. Magn. Gidrodin.; No. 3, 132-133(1973). (In Russian).

In order to explain the nonmonotonic dependence of the energy of turbulent pulsations of the longitudinal component of the velocity as a function of the magnetic field in circular flow, measured earlier with a thermoanemometer of a narrow type, analogous measurements were carried out with a wide-type meter which did not perturb the flow. In this case with increasing magnetic field the pulsations fell monotonically to background level. Thus the anomalous character of the dependence obtained earlier is actually associated with the breakup of Karman eddies from the jaws of the measuring instrument, and laminar flow with increasing magnetic field was attained under conditions of strong flow perturbation. (tr-auth)

27737 CONDITIONS OF SIMILITUDE AND MODELING OF LIQUID-METAL AGITATION BY A TRAVELING MAGNETIC FIELD. Briskman, V. A.; Krivonishchenko, I. A.; Kropachev, G. P. Magn. Gidrodin.; No. 3, 119-124(1973). (In Russian).

The study presents all systems of dimensionless criteria that are obtained by a direct application of the π-theorem to an analysis of similitude conditions in the motion of molten metals in a traveling magnetic field. A total of seven physical parameters are required in the problem: the size and strength of the magnetic field, the angular velocity of the magnetic field, the electrical conductivity, density and dynamic viscosity of the liquid, and the magnetic constant. It is shown that the use of these criteria is not always suitable. Dimensionless criteria which are correct for modeling liquid metal agitation by a traveling magnetic field are presented. A direct proportionality is noted between the field tension and liquid velocity at large Reynolds number. (SJR)

27738 DETERMINING EFFECTIVE CONDUCTIVITY OF A METALLIC PARTICLE IN CROSSED ELECTRIC AND MAGNETIC FIELDS. Gorovits, V. S. Magn. Gidrodin.; No. 3, 111-118(1973). (In Russian).

Determination of the current passing through a metallic particle in an electrolyte on application of crossed electric and magnetic fields is necessary in solving many problems associated with MHD-separation and with the use of MHD-methods in hydrometallurgical processes. The force acting on the metallic particle depends in a nonlinear fashion on the magnitude of the applied electric field. A solution is obtained for the problem of convective diffusion to a spherical particle in a viscous, electrically-conducting liquid. The results were confirmed experimentally. The effect of various factors on the effective conductivity of a particle in an electrolyte is considered. The effective conductivities of a copper sphere and of a nickel-clad copper sphere were determined in a caustic solution held in a glass cuvette immersed in the gap of a C-shaped electromagnet so that the electric and magnetic fields were mutually perpendicular. (SJR)

27739 NONSTEADY-STATE FLOW OF A LAYERED GAS STREAM IN THE CHANNEL OF AN MHD GENERATOR. Slavin, V. S. Magn. Gidrodin.; No. 3, 63-70(1973). (In Russian).

Layered flow in the channel of a MHD-generator is created by zones of a heated conducting gas, which periodically appear in a stream of a "cold" non-conducting medium. In the generator channel as a result of the interaction of hot layers with the magnetic field the flow becomes essentially non-steady-state. A model is used in which the current-bearing layers are replaced by weightless pistons which slow down the stream of nonconducting gas. A given electrodynamic force is assigned to the pistons. The problem is solved numerically by the method of characteristics. The character of time changes in the distribution of gas parameters is found along the stream. Data are presented on calculating the enthalpy conversion efficiency in the generator process, and it is shown the efficiency for layered flow can be higher than for continuous flow. (tr-auth)

27740 USE OF OPTICAL METHODS IN STUDYING MHD PROCESSES. Fedin, A. G. Magn. Gidrodin.; No. 3, 15-24(1973). (In Russian).

The use of Schlieren photography, interferometry and lasers are reviewed in the study of flow phenomena in magnetic fields. Schlieren photography depends on detecting changes in temperature or density from changes in the refractive index of the solution which can be photographed. This effect is enhanced by use of an equimolar solution of ferri-ferrocyanides in a magnetic field. By means of Schlieren methods it is possible to observe the change in thickness of a laminar layer in a magnetic field, to study the effect of magnetic field and flow rate on the characteristics of the laminar layer, and to investigate the laminar-turbulent transition. By means of various modifications of the Schlieren method it is also possible to obtain distributions of temperatures, concentrations and flow rates. Interferometry methods are capable of more exact results, but are more difficult to use. This method can be separated into three groups: 1) slit and needle, 2) diffraction, and 3) polarization interferometers. These methods require monochromatic light sources of high brightness in one direction. Compensating cuvettes are used to equalize the difference in light paths between a standard and the unknown path of light. Various methods use the specific properties of lasers in studying MHD-flow: 1) laser interferometry, 2) holographic interferometry, 3) methods based on the use of the Doppler effect, and 4) methods based on the absorption, scattering and deflection of laser radiation on passage through various media. Laser radiation is readily focused; the equipment is easy to adjust; the radiation is intense. Measurements in a laminar layer 0.1 mm thick were carried out to an accuracy of 5% by the combined use of laser radiation and Schlieren photography. In holography the object is irradiated with coherent laser radiation, and the reflected light from the object and light from a standard source are sent to a film to give an interferometric pattern. Considerable information can be extracted from the hologram since the amplitude and phase of the light wave are recorded. The Doppler method measures velocities over a considerable range from 10^{-5} to 10^{5} m/sec with good time and spatial resolution (10^{-11} cm^3). These optical methods have many advantages over other methods. (67 references) (SJR)

27741 UNSTEADY MHD FLOW NEAR AN INFINITE FLAT WALL. Pop, I. (Univ., Cluj). Proc. Indian Acad. Sci., Sect. A; 78: No. 6, 231-238(Dec 1973).

The flow of an electrically conducting incompressible viscous fluid near an infinite flat wall in the presence of a magnetic field when the free stream velocity is to be expressed in power series of $\sqrt{t}$ is considered. The effect of the magnetic field strength on the velocity field induced magnetic field and skin friction is analyzed for two particular cases of the free stream velocity. (auth)

27742 STRONG CYLINDRICAL SHOCKS IN MAGNETOGASDYNAMIC HOMOTHERMAL FLOWS. Verma, B. G. (Univ. of Gorakhpur, India). Nuovo Cim.; 20B: No. 1, 203-208(11 Mar 1974).

It is shown that the equations of motion governing homothermal flows behind cylindrical shocks in magnetogasdynamics become amenable to analytic solutions under the assumption of a strong magnetic field and certain restricted values of the similarity exponent. (auth)

27743 MEASURING CHARACTERISTICS OF MHD FLOW OF MERCURY IN A CLOSED CYLINDRICAL VESSEL. Doronin, V. I.; Dremov, V. V.; Kapusta, A. B. Magn. Gidrodin.; No. 3, 138-140(1973). (In Russian).

In a closed cylindrical vessel of stainless steel the velocity and acceleration of an azimuthal mercury stream in a rotating magnetic field were investigated at Hartmann numbers >0.4

but <18 by means of a special nonconducting rotor with a radius of 20 mm, one of whose blades was tagged with radioactive cobalt. The rotor was fastened to a thin nonmagnetic rotor mounted on the symmetry axis of the vessel. It is shown that the measured velocities are smaller than the theoretical values by approximately a factor of 4. The explanation is that the theoretical equation describes the velocity of a laminar, one-dimensional stream, while a three-dimensional, laminar-eddy flow is established experimentally. The transition from laminar to laminar-eddy flow in a closed vessel takes place at Hartmann numbers much smaller than 0.4. Change of flow is also noted on acceleration and deceleration of the liquid. (SJR)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 27837, 27856, and 27859.

Electromagnetic

Refer also to abstract 27839.

27744 (AD-766971-6) ANNUAL REPORT FOR 1972. (Saskatchewan Univ., Saskatoon (Canada). Saskatchewan Accelerator Lab.). 15 Nov 1972. 114p. NTIS $7.75.

The topics covered are: electron scattering experiments; photo- and electro-disintegration experiments; research with low energy facility (pulse radiolysis); accelerator operation; accelerator modification; theoretical studies on the storage ring project; health physics--radiation exposure of personnel; residual activity; area monitoring. (GRA)

27745 (DESY-73-56) PHENOMENOLOGICAL FITS TO THE NUCLEON ELECTROMAGNETIC FORM FACTORS BASED ON VECTOR-MESON DOMINANCE. Felst, R. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Nov 1973. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

Experimental data on the electromagnetic form factors of the proton and the neutron are compiled and compared with several model predictions based on vector meson dominance. Higher mass vector mesons are necessary to provide a quantitative description of the available data. The vector meson nucleon coupling constants obtained and the cross sections of the $e^+e^- \rightarrow p\bar{p}$ and $e^+e^- \rightarrow n\bar{n}$ processes predicted from these models are presented. (auth)

27746 (INS-J-144) DIFFERENTIAL CROSS SECTION OF ETA MESON PHOTOPRODUCTION AT 890 MeV AND 1050 MeV. Yoshida, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 1 Feb 1974. 47p. Dep. NTIS (U. S. Sales Only) $5.50.

Thesis. Submitted to Nagoya Univ., Japan.

The differential cross section for the process $\gamma + p \rightarrow \eta + p$ was measured at the center of mass angles $\theta_\eta^* = 82.3°$ and 108.3° for an incident photon energy k = 890 MeV, and at $\theta_\eta^* = 83.1°$ for k = 1050 MeV. A magnetic spectrometer system and a total-absorption Cerenkov counter were used to detect recoil protons and produced eta mesons, respectively. Eta-meson events were confirmed from the energy spectrum of photons through the decays $\eta \rightarrow 2\gamma$, measured with the Cerenkov counter. The background contribution to be rejected consisted mainly of the events from double neutral-pion production. A semi-empirical formula for the background process was obtained by comparing the data of background measurements with a Monte Carlo calculation. The angular distribution of eta-meson photoproduction at k = 890 MeV showed a considerable enhancement in the backward direction. A phenomenological analysis was made for the present data and those of the recoil proton polarization, the latter being obtained in the other part of this experiment. Sizable contribution of the $D_{13}(1518)$ in addition to the dominant $S_{11}(1535)$ is needed to reproduce the experimental data. An effect of the $P_{11}(1470)$ is not so conclusive and it needs further investigation of this process. (auth)

27747 (SLAC-167(Vol. 1), pp 137-155) RESULTS ON ELECTROPRODUCTION EXPERIMENTS FROM DESY. Meyer, H. (Univ. of California, Santa Cruz). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume I.

A summary of experimental results on hadron production in inelastic electron scattering is given. The experimental setups and kinematic region covered are described. (JFP)

27748 (SLAC-167(Vol. 1), pp 177-189) FURTHER MEASUREMENTS OF FORWARD CHARGED PION ELECTROPRODUCTION AT LARGE K^2. Bebek, C. J. (Harvard Univ., Cambridge, MA); Brown, C. N.; Herzlinger, M.; Holmes, S.; Lichtenstein, C. A.; Pipkin, F. M.; Sisterson, L. K.; Andrews, D.; Berkelman, K.; Cassel, D. G.; Hartill, D. L. Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume I.

Measurements of the electroproduction reaction $e^- + p \rightarrow e^- + \pi^+ + n$ carried out at the Wilson Synchrotron Laboratory are reported. For fixed virtual photon-hadron center of mass energy, W = 2.67 GeV, data are presented with the mass of the virtual photon, $-k^2$, centered at 0.6, 1.2, and 2.0 $(GeV)^2$. At the central $-k^2 = 1.2$ $(GeV)^2$ point results are also given for W = 2.15 GeV. For the W = 2.67, $-k^2 = 1.2$ $(GeV)^2$ setting an angular scan is presented and the scalar transverse interference term is extracted. The data are compared with a dispersion theory calculation of Berends which has as its only free parameter the pion electromagnetic form factor. The theory is used to give a new determination of the pion form factor up to $-k^2 = 2.0$ GeV^2. (auth)

27749 (SLAC-167(Vol. 1), pp 191-198) MEASUREMENTS OF INCLUSIVE PION ELECTROPRODUCTION. Bebek, C. J. (Harvard Univ., Cambridge, MA); Brown, C. N.; Herzlinger, M.; Lichtenstein, C. A.; Pipkin, F. M.; Sisterson, L. K.; Andrews, D.; Berkelman, K.; Cassel, D. G.; Hartill, D. L. Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume I.

Measurements of the inclusive pion electroproduction reaction $e^- + p \rightarrow e^- + \pi^\pm + X$ made at the Wilson Synchrotron Laboratory are reported. Data were taken at points with nominal (Q^2, W) values of (0.6, 2.67), (1.2, 2.67), (2.0, 2.67) and (1.2, 2.15) in (GeV^2, GeV). A more complete angular distribution was taken at (1.2, 2.67). The virtual photoproduction cross section for π^+ + missing mass is studied as a function of missing mass, Feynman scaling variables, Q^2 and W. The invariant cross section shows a simple behavior as a function of Q^2 and W. Its dependence on W, $p_\perp^2$, x' and ϕ is determined. (auth)

27750 (SLAC-167(Vol. 1), pp 199-213) ELECTROPRODUCTION OF PROTONS IN THE FORWARD DIRECTION. Bebek, C. J. (Harvard Univ., Cambridge, MA); Brown, C. N.; Herzlinger, M.; Lichtenstein, C. A.; Pipkin, F. M.; Sisterson, L. K.; Andrews, D.; Berkelman, K.; Cassel, D. G.; Hartill, D. L. Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume I.

Data taken at the Wilson Synchrotron Laboratory on electroproduction of protons are presented in which a proton moving in approximately the same direction as the virtual photon is detected. Measurements were made at data points with nominal (Q^2, W) values of (0.6, 2.67), (1.2, 2.67), (2.0, 2.67) and (1.2, 2.15) in (GeV^2, GeV). The virtual photoproduction cross section for p + missing mass is studied as a function of missing mass, Feynman scaling variables x and $P_\perp^2$, azimuthal angle ϕ, Q^2 and W. The invariant cross section shows a simple behavior as a function of Q^2 but not W. Its dependence on W, $P_\perp^2$, x' and ϕ is determined. (auth)

27751 (SLAC-167(Vol. 1), pp 215-226) ELECTROPRODUCTION OF K^+ MESONS IN THE FORWARD DIRECTION. Bebek, C. J. (Harvard Univ., Cambridge, MA); Brown, C. N.; Herzlinger, M.; Hicks, N.; Holmes, S.; Lichtenstein, C. A.; Pipkin, F. M.; Sisterson, L. K.; Andrews, D.; Berkelman, K.; Cassel, D. G.; Hartill, D. L. Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume I.

Data are presented taken at the Wilson Synchrotron Laboratory on electroproduction of protons in which a K^+ meson moving in approximately the same direction as the virtual photon is detected. Measurements were made of data points with nominal (Q^2, W) values of (0.6, 2.67), (1.2, 2.67), (2.0, 2.67) and (1.2, 2.15) in (GeV^2, GeV). The virtual photoproduction cross section for K^+ + missing mass is studied as a function of missing mass, Feynman scaling variables, Q^2 and W. The data show that the $K^+ \Sigma^0$ cross section falls more rapidly than the $K^+ \Lambda^0$ cross section as Q^2 increases. There is evidence for hyperon resonance production. The variation with Q^2 of the K^+/π^+ ratio is determined. (auth)

27752 (SLAC-167(Vol. 1), pp 255-287) e^+e^- REACTIONS AT THE CEA (2.0 AND 2.5 GeV PER BEAM). Newman, H. (Massachusetts Inst. of Tech., Cambridge). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume I.

Cross sections for various $e^+ + e^-$ interactions were measured. Also quantum electrodynamics was verified from these data. (JFP)

27753 (SLAC-167(Vol. 1), pp 313-325) RECENT e^+e^- COLLIDING BEAM RESULTS. Schwitters, R. F. (Stanford Linear Accelerator Center, CA). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume I.

A review is given of experimental results on $e^+ + e^-$ interactions in colliding beams which have appeared since the Batavia Conference. Test of quantum electrodynamics and hadron form factors are considered. (JFP)

27754 (SLAC-167(Vol. 1), pp 355-369) MEASUREMENT OF CHARGED HADRON MULTIPLICITIES IN DEEP INELASTIC ELECTRON SCATTERING. Berkelman, K. (Cornell Univ., Ithaca, NY); Garbincius, P. H.; Gibbard, B.; Wanderer, P.; Sadoff, A. J. Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9–28, 1973. Volume I.

Measurements of the charged hadron multiplicities for electrons scattered at momentum transfers up to $Q^2 \approx 9$ GeV^2, and for 5 up to 16 GeV^2. Electrons are scattered in a 2.5 cm liquid hydrogen target and detected in a large-aperture spectrometer consisting of a bending magnet, proportional wire chambers, and a shower hodoscope. Charged hadrons are detected in an array of 68 scintillators almost completely surrounding the target. Data on the laboratory angular distributions will also be presented. This is a preliminary report of an experiment which is still in progress. The results are tentative and subject to change as data taking and analysis proceeds. (auth)

27755 (UH-511-164-73) TRANSITION RADIATION X-RAY YIELDS AND SPECTRA FROM ELECTRONS OF 1.3 TO 15 GeV/c. Peterson, V. Z. (Hawaii Univ., Honolulu (USA)). 1973. 3p. Dep. NTIS $3.00.

Transition radiation (TR) from electrons of 1.3, 3.0, 6, 9, 12, and 15 GeV/c momentum was detected by using noble gas (argon, krypton, or xenon) multiwire proportional chamber (MWPC) detectors. Radiator-detector arrays of "sandwich" type or "magnetic separation" type were used. TR x-ray spectra and total yields were measured and compared with theoretical predictions. (5 figures) (auth)

27756 PHOTOPRODUCTION OF PHI MESONS ON PROTONS AT 2.0 GeV. Besch, H. J.; Hartmann, G.; Kose, R.; Krautschneider, F.; Paul, W.; Trinks, U. (Univ., Bonn). Nucl. Phys.; B70: No. 2, 257-271(1974).

At the Bonn 2.5 GeV synchrotron the differential photoproduction cross section $d\sigma/dt$ of ϕ mesons was measured at a photon energy of 2.0 GeV at five different t values between $0.23 < |t| < 0.73$ (GeV/c)^2. The ϕ meson was detected by magnetic momentum analysis of both charged decay K mesons and by a time of flight and angle measurement of the coincident recoil proton. An exponential behavior for the t dependence of the cross section was found. The measured slope of the exponential decrease was $b = (4.01 \pm 0.23)$ (GeV/c)$^{-2}$. This result, combined with previous measurements at higher energies, implies that the slope of the pomeron trajectory is compatible with zero. In addition the experiment yielded a value of the ϕ mass, $m_\phi = (1019.4 \pm 0.8)$ MeV and a value of the ϕ width, $\Gamma_\phi = (4.4 \pm 0.4)$ MeV. (auth)

27757 PHOTOPRODUCTION OF CHARGED PIONS ON DEUTERIUM IN THE FIRST RESONANCE REGION. von Holtey, G.; Knop, G.; Stein, H.; Stuempfig, J.; Wahlen, H. (Univ., Bonn). Nucl. Phys.; B70: No. 3, 379-389(1974).

Photoproduction of π^+ and π^- on deuterium was measured in the photon energy range from 240 to 400 MeV and for pion c.m. angles between 15° and 180°. The pions were analyzed in angle and momentum by a magnetic spectrometer. From the measured π^-/π^+ ratio, corrected for Coulomb interactions in the final state, differential cross sections of the reaction $\gamma + n \rightarrow \pi^- + p$ were calculated. Together with the π^+ photoproduction the data show no isotensor contribution. Comparison of the data with the recent experiments done on the inverse reaction shows no evidence of a violation of time reversal invariance. With the measured π^+ photoproduction on deuterium, a test of the spectator model has been made. Using the closure-approximation of Chew and Lewis the data agree within a range of ±10%. (auth)

27758 SEARCH FOR PHOTOPRODUCTION OF BOSONS BY THE MISSING-MASS TECHNIQUE AND MEASUREMENT OF THE s AND t DISTRIBUTION OF THE PHOTOPRODUCED HADRONIC CONTINUUM. Gladding, G.E.; Russell, J.J.; Tannenbaum, M.J.; Weiss, J.M.; Thomson, G.B. (Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 8: No. 11, 3735-3744 (1 Dec 1973).

The reaction $\gamma + p \rightarrow p + m^0$ was studied with a tagged-photon beam of energy range 1.90 to 4.70 GeV. No new resonances were seen in the state m^0 but instead a large nonresonant production was observed. The s and t dependence of this continuum production were measured and found to have interesting properties. The recoil-proton spectra from the photoproduced continuum are found to strongly resemble recoil-proton spectra from hadron-initiated reactions. (auth)

27759 MEASUREMENT OF PHOTOPRODUCTION OF ω^0 AND ρ^0 MESONS IN HYDROGEN. Gladding, G.E.; Russell, J.J.; Tannenbaum, M.J.; Weiss, J.M.; Thomson, G.B., (Harvard University, Cambridge, Massachusetts 02138); Phys. Rev. D 8: No. 11, 3721-3734 (1 Dec 1973).

The t distribution for photoproduction of ρ^0 and ω^0 mesons from hydrogen has been measured for incident energies between 2.9 and 4.7 GeV. A Soding interference model fits the ρ^0 data and gives t distributions in agreement with π^+p elastic scattering and most previous ρ^0 experiments. The ω^0 t distribution changes with incident energy but in our highest-energy bin $3.7 \leq k \leq 4.7$ GeV becomes diffractive and is consistent with being equal to a constant times the ρ^0 t distribution. (auth)

27760 PROTON COMPTON SCATTERING AT 0.55–TO–4.5–GeV ENERGY AND 0.12–TO–1.0–(GeV/c)^2 MOMENTUM TRANSFER. Deutsch, M.; Cleetus, K.J.; Golub, L.; Jacobs, D.F.; Kijewski, P.; Loh, E.; Marini, G.; Patel, P.M.; Potter, D.; Stiening, R.; Tsipis, K. (Laboratory of Nuclear Science, and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 8: No. 11, 3828-3847 (1 Dec 1973).

Results are presented on the elastic scattering of photons by protons. The incident photon energy ranged from 0.55 GeV to 4.5 GeV, and the four-momentum transfer t ranged from 0.12 to 1.0 (GeV/c)^2. The data at large angles, $60° < \theta^* < 115°$, are characterised by a pronounced excitation of the $D_{13}(1518)$ resonance, a shoulder in the 1688-MeV mass region, and a precipitious drop thereafter in the the cross section as a function of incident energy. The low-t data are characterized by a diffraction slope of 5 (GeV/c)$^{-2}$. The data are inconsistent with the predictions of the vector-dominance model if the latter is restricted to ρ^0, ω, and ϕ vector mesons. (auth)

27761 ASYMMETRY OF THE CROSS SECTION OF THE REACTION $\gamma d \rightarrow \pi^0 d$ AT A PHOTON ENERGY 350 MeV. Ganenko, V. B.; Gorbenko, V. B.; Zhebrovskii, Yu. V.; Kolesnikov, L. Ya.; Miroshnichenko, I. L.; Naisteter, S. I.; Rubashkin, A. L.; Sanin, V. M.; Sorokin, P. V. (Physical-Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.); 18: No. 8, 284-286(20 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 8, 483-486(20 Oct 1973).

Results of the measurement of the asymmetry of the cross section of the reaction $\gamma + d \rightarrow \pi^0 + d$ by polarized photons at 350 MeV and the results of a calculation of the angular distributions of the cross section asymmetry in the photon energy range from 180 to 800 MeV in the S and S + D wave approximation are presented. (JFP)

27762 ELECTRON–POSITRON STORAGE RING EXPERIMENTS. Strauch, K. (Cambridge Electron Accelerator, MA). (1973). 53p.

From international symposium on electron and photon interactions at high energies; Bonn, Germany (27 Aug 1973).

A summary is given of new experimental results with electron-positron storage rings that have become available since the 1971 Cornell Conference. The following quantum electrodynamics experiments are discussed: elastic electron-positron scattering, two-photon annihilation, large-angle bremsstrahlung production, lepton pair production and the search for heavy leptons. Quantum electrodynamics is verified by these reactions in new space-like and time-like regions of q^2. Also hadron production is considered. After a short report on the hadron pair production reactions $e^+ + e^- \rightarrow \pi^+ + \pi^-$ and $e^+ + e^- \rightarrow K^+ + K^-$, a detailed description is given of new multi-hadron production experiments for $s > 6$ GeV^2. Unexpectedly, the cross section for multi-hadron production is found to be larger than the point pair annihilation cross section. (GE)

27763 PRECISE OMEGATRON MEASUREMENT OF μ_p/μ_N. Petley, B. W.; Morris, K. (National Physical Lab., Teddington, Eng.). J. Phys., A (London); 7: No. 2, 167-182(21 Jan 1974).

The value obtained for the proton magnetic moment in nuclear magnetons was 2.792 774 8 ± 0.000 002 0 (0.72 ppm) without the diamagnetic shielding correction. Measurements were made with a quadrupole omegatron at flux densities of 0.47, 0.94, and 1.41 T. More than 400 sets of measurements were made using H_2^+, HD^+, D_2^+, $^4He^+$ ions and protons. (auth)

27764 TWO HIGH-PERFORMANCE SPECTROMETERS FOR ELECTRON SCATTERING AT THE 600 MeV LINEAR ACCELERATOR OF SACLAY. Barreau, P.; Bellicard, B.; Bounin, P.; Grunberg, C.; Leconte, P.; Millaud, J.; Mougey, J.; Tomasso, A. (CEN de Saclay, Gif-sur-Yvette, France). Kakuriken Kenkyu Hokoku; 5: 131-138(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The experimental set-up is described for high energy resolution electron scattering ($\leq 2.10^{-4}$) and (e,e'p) reactions where both emitted particles are detected in coincidence. (JFP)

27765 STUDY OF THE CHARGE ASYMMETRY IN ELECTROMAGNETIC INTERACTIONS OF COSMIC RAY MUONS.

Nandi, B. C. (Regional Engineering Coll., Durgapur, India). Nucl. Phys.; B70: No. 1, 161-167(1974).

The Durgapur cosmic ray spectrograph was utilised to study the electromagnetic interaction of cosmic ray muons in iron in the momentum range 5 to 100 GeV/c. The dependence of the interaction cross section on the charge of the muons for the production of a single electron secondary due to the knock-on process and for two and more than two electrons due to both knock-on and pair production was investigated. The ratio of the interaction cross section for positive muons to that for negative muons in the magnet-iron was found to be 0.952 ± 0.045 for the production of one secondary particle. For production of two and more than two secondaries the ratios are 1.05 ± 0.09 and 0.91 ± 0.08 respectively. The present results do not indicate any charge asymmetry of cosmic ray muons in respect of electromagnetic interactions in iron. (auth)

27766 PHOTOPRODUCTION OF CHARGED PIONS IN THE ENERGY RANGE NEAR THE THRESHOLD. Adamovich, M. I. Tr. Fiz. Inst., Akad. Nauk SSSR; 71: 120-216(1973). (In Russian).

An experimental study is made of the processes for the photoproduction of charged pions on H and D nuclei in the photon energy range from threshold up to 230 MeV. Data on the elementary processes of photoproduction on free nucleons are reported. A phenomenological amplitude analysis is made. As a result of the comparison of the experimental and theoretical models data on the effect of nucleon and meson resonances on the photoproduction of pions are reported. The pion-nucleon interaction constants and the constants characterizing the width of the radiation decay of ρ mesons are determined. (164 references) (tr-auth)

27767 TWO-PHOTON ANNIHILATION INTO A PION PAIR. Orito, S. (CNEN, Frascati, Italy); Ferrer, M. L.; Paoluzi, L.; Santonico, R. Phys. Lett.; 48B: No. 4, 380-384(18 Feb 1974).

The first experimental study of the interaction $\gamma\gamma \to \pi^+\pi^-$ was carried out in the region of $\epsilon(660)$ through the reaction $e^+e^- \to e^+e^-\pi^+\pi^-$. Based on two observed events, the $\gamma\gamma$ width of $\epsilon(660)$ is obtained to be $\Gamma_{\epsilon\gamma\gamma} = 9.6^{+1}_{-3}{}^{+3}_{-3}$ keV. Applied on this, theory of P.C.D.C. anomaly predicts $R_- = 5.8^{+4}_{-2}{}^{+3}_{-3}$ for the asymptotic value of $\sigma(e^+e^- \to \text{hadrons})/\sigma(e^+e^- \to \mu^+\mu^-)$. (auth)

27768 ELECTRON AND MUON SPECTRUM OF EXTENSIVE AIR SHOWERS. Khristiansen, G. B.; Kulikov, G. V.; Solov'eva, V. I. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz.; 19: No. 2, 327-330(Feb 1974). (In Russian).

The present data on the electron and muon spectra of the extensive air showers (EAS) are analyzed. The data show two irregularities in both electron and muon spectra. The observed variation of the shape reflects the corresponding variation of the shape of the energy spectrum of the primary ultrahigh energy cosmic rays. (auth)

27769 MEASUREMENT OF THE PHOTON LINEAR POLARIZATION IN THE ELEMENTARY BREMSSTRAHLUNG PROCESS. Behncke, H. H.; Nakel, W. (Univ., Tuebingen, Ger.). Phys. Lett.; 47A: No. 2, 149-150(11 Mar 1974).

In an electron-photon coincidence experiment the linear polarization of atomic-field bremsstrahlung was measured for a fixed direction of outgoing electrons. A polarization of $P = -0.96 \pm 0.32$ was found which is in agreement with theoretical calculation. Electrons of 300 keV are used, incident on a carbon target. (auth)

Weak

Refer also to abstract 27926.

27770 (INIS-mf-1012) EXPERIMENTAL STUDY OF K^+_{e4} DECAY. The Determination of the Branching Ratio, Form Factors, and $\pi-\pi$ Phase Shift. Esveld, C. D. (Katholieke Universiteit Nijmegen (Netherlands)). 4 Oct 1973. 122p. INIS.

An experiment on K^+ mesons decaying in a bubble chamber is described. The K^+_{e4} decay, $K^+ \to \pi^+\pi^-e^+\nu$, was investigated. Within the framework of the so-called X2 collaboration the K^+_{e4} candidates were measured and analyzed in five European laboratories (Aachen, Brussels, CERN, Padova and Nijmegen). The experimental set-up and the collection of the data are described. The methods used to separate as many good events as possible from the background and to correct for missed events are dealt with. The analysis of the selected events using both the maximum-likelihood method and the least-squares method are treated. The results of these analyses are experimental values for the K^+_{e4} branching ratio, the $\pi-\pi$ phase shift, the form factors f_s, f_p, f'_p, g and h and their ratios, ν, η and γ. These values are compared with the results of similar experiments carried out with bubble chambers as with counters and spark chambers. Nearly all K^+_{e4} events, previously detected in bubble chambers, are reanalyzed. It appears that the various results are roughly in agreement. Good correspondence exists between the values for the branching ratio and between the values for a "privileged" combination of form factors $\nu + 5\eta$. Some theoretical predictions are reviewed and compared with the experimental results. As the predictions of the form factors differ rather strongly among themselves a meaningful conclusion is not possible. For the $\pi-\pi$ phase shift and the scattering length a_0 the predicted and experimental values agree well. (auth)

27771 (SLAC-167(Vol. 1), pp 157-176) HADRONIC FINAL STATES FROM INELASTIC MUON SCATTERING IN A HYBRID BUBBLE CHAMBER EXPERIMENT. Carroll, J. T. (Stanford Linear Accelerator Center, CA). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume I.

A study is made of hadronic final states in inelastic muon scattering in a hydrogen bubble chamber. The positive Q^2 region is studied, and nucleon structure functions are found to scale for $Q^2 > 1$ GeV^2 and $W > 2$ GeV. Most data fall in the region between photoproduction and scaling. The experiment is basically a survey experiment designed to study the qualitative features of the hadronic final states in this transition region. Cross sections, multiplicities, inclusive distributions, and resonance production including ρ^0, Δ^{++}, ω, ρ^-, and A_1^+ are studied. The ρ decay angular distributions are discussed. (JFP)

27772 (SLAC-167(Vol. 1), pp 227-238) HIGH ENERGY NEUTRINO SCATTERING AT NAL. Shields, D. (California Inst. of Tech., Pasadena). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume I.

The data at $E_\nu = 50$ GeV are qualitatively consistent with expected behavior (quark parton model—no anti-quarks). The dependence of $\langle Q^2 \rangle$ on E_ν agrees with scaling down to distances of 4×10^{-15} cm. (auth)

27773 (SLAC-167(Vol.2), pp 129-139) SEARCH FOR EXOTIC EFFECTS IN WEAK INTERACTIONS. Sciulli, F. (California Inst. of Tech., Pasadena). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume II.

Preliminary results are given for the energy spectra for the reaction $\nu_\mu + N \to \mu^- + \text{hadrons}$, the lack of evidence for W^+ production in $\nu_\mu + N \to \mu^- + W^+ + N(\text{hadrons})$ and the production of heavy leptons in the reaction $\nu_\mu + N \to \gamma^+ + \text{hadrons}$ from which it is found that $M_\gamma > 2\text{GeV}/c^2$. (JFP)

27774 (SLAC-167(Vol.2), pp 155-165) PRESENT STATUS OF $K^0_1 \to \mu^+\mu^-$ EXPERIMENTS. Nygren, D. R. (Lawrence Berkeley Lab., Berkeley, CA). Nov 1973.

In Proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume II.

The review of the present status of $K^0_1 \to \mu^+ + \mu^-$ decay experiments includes $K^0_2 \to 2\gamma$, $K^0_2 \to 2\mu$, and lower bounds for the branching ratio $K^0_1 \to 2\mu$ decays. (JFP)

27775 (SLAC-167(Vol.2), pp 167-202) K_{l3} FORM FACTORS: EXPERIMENTAL REVIEW AND NEW RESULTS. Hitlin, D. (Stanford Univ., CA). Nov 1973.

In Proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume II.

The theoretical and experimental situation on the form factors in K_{l3} decays is reviewed. Results of a new high statistics measurement of the Dalitz plot in $K^0_{\mu 3}$ decay are presented. The results of this new experiment are in accord with current algebra and PCAC predictions for the scalar form factor as well as with μ-e universality and K^* dominance of the vector form factor. (auth)

27776 (SLAC-167(Vol.2), pp 203-211) NEW DEVELOPMENTS IN THE K_S DECAY PARAMETERS AND THE CP VIOLATION PARAMETERS IN THE K_L SYSTEM. Nauenberg, U. (Univ. of Colorado, Boulder). Nov 1973.

In Proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume II.

The review covers the history of the K^0_1 lifetime, the K^0_1 branching ratio, the existence of the $\Delta I = \frac{1}{2}$ and $\frac{3}{2}$ amplitude in these decays, and the $K^0_1 - K^0_2$ mass difference and phase. (JFP)

27777 (SLAC-167(Vol.2), pp 213-224) TESTS OF GAUGE THEORIES IN NEUTRINO SCATTERING EXPERIMENTS. De Rujula, A. (Harvard Univ., Cambridge, MA). Nov 1973.

In Proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume II.

The testable consequences of the fact that in most renormalizable gauge theories the hadron current is significantly different from the low energy phenomenological Cabibbo current are treated. Inclusive neutrino reactions on targets consisting of an approximately equal number of protons and neutrons are considered. The

possible multiple scaling and other peculiarities of neutrino scattering in the context of gauge theories, tests of the charge symmetry properties of the charged weak hadron current, exact sum rule statements within particular gauge models, and the simplest experimental ways of testing them are included. (JFP)

27778 (SLAC-167(Vol.2), pp 235-249) LATEST RESULTS FROM GARGAMELLE NEUTRINO EXPERIMENTS. Wachsmuth, H. (CERN, Geneva). Nov 1973.

In Proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume II.

The review of the latest results for the neutrino experiments covers a brief description of the experiments, results of weak current studies with muonic and electronic neutrinos, and neutral current search. (JFP)

27779 (UH-511-166-73) ANNUAL PROGRESS REPORT OF THE HIGH-ENERGY PHYSICS GROUP. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). 7 Nov 1973. Contract AT(04-3)-511. 125p. Dep. NTIS $8.25.

Research on high energy physics is summarized and includes neutrino physics, the external muon identifier, search for leptons, and transition radiation. A list of publications is included. (JFP)

27780 SEARCH FOR RARE K^+ DECAYS: PART II, $K^+ \to \pi^+\nu\bar{\nu}$. Cable, G.D. (Enrico Fermi Institute, The University of Chicago, and Department of Physics, The University of Arizona, Tucson, Arizona 85721); Hildebrand, R.H.; Pang, C.Y.; Stiening, R. Phys. Rev. D 8: No. 11, 3807-3812 (1 Dec 1973).

In a counter experiment at the Lawrence Berkeley Laboratory Bevatron we have searched for the process $K^+ \to \pi^+\nu\bar{\nu}$ in the kinetic energy interval $60 < T_\pi < 105$ MeV and have found no examples of this decay mode. Combining our data with those of Klems, Hildebrand, and Stiening for the interval $117 < T_\pi < 127$ MeV, we obtain the limit $\Gamma(K^+ \to \pi^+\nu\bar{\nu}) < 5.6 \times 10^{-7}\,\Gamma(K^+ \to \text{all})$, assuming a (vector) pion spectrum like that for $K^+ \to \pi^0 e^+\nu$. Limits are presented for other assumed spectra. (auth)

27781 FURTHER OBSERVATION OF THE DECAY $K_L^0 \to \mu^+\mu^-$. Carithers, W.C.; Nygren, D.R. (Columbia University, New York, New York, 10027); Gordon, H.A.; Ioffredo, M.L.; Lai, K.; Weilhammer, P. Phys. Rev. Lett. 31: No. 16, 1025-1028 (15 Oct 1973).

A new search for the decay $K_L^0 \to \mu^+\mu^-$ has been performed at the Brookhaven National Laboratory alternating-gradient synchrotron. We used the experimental technique employed by Carithers et al., with some modifications to suppress the background further and eliminate possible systematic effects. The analysis of this experiment yields three events satisfying criteria for this decay mode. (auth)

27782 PRECESSION OF μ^+ IN SINGLE CRYSTAL NICKEL. Patterson, B. D. (Univ. of California, Berkeley); Crowe, K. M.; Gygax, F. N.; Johnson, R. F.; Portis, A. M.; Brewer, J. H. Phys. Lett.; 46A: No. 7, 453-454(11 Feb 1974).

Long-lived μ^+ precession was observed in single crystal nickel at 300 and 77K. Inhomogeneous local fields which cause rapid depolarization in polycrystalline samples are avoided. Muon precession in a magnetically saturated sample is reported. (auth)

27783 DEPOLARIZATION OF NEGATIVE MUONS IN CONDENSED MOLECULAR MEDIA. Dzhuraev, A. A.; Evseev, V. S.; Obukhov, Yu. V.; Roganov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 66: No. 2, 433-442(Feb 1974). (In Russian).

A correlation is established between the residual polarization of negative muons in matter and the radiative stability of the matter. It is shown that the correlation observed can be satisfactorily explained by a formal theory based on the concept of rapid reactions between meso-radicals and the environment. The rates of participation of the meso-radicals in chemical reactions in various types of hydrocarbons are determined. The asymmetry coefficients for μ^--decay electrons in aqueous solutions of hydrogen peroxide of various concentrations at room temperature are measured by the precession technique. The asymmetry coefficient for a peroxide solution with a concentration of 97 wt. % at a temperature of 80°K is measured. The rates of chemical reactions involving meso-nitrogen are determined. It is shown that the activation energy of the chemical reaction between mesic nitrogen $_\mu N$ and hydrogen peroxide molecules must be taken into account. The depolarization temperature dependence is measured for a number of organic compounds. (auth)

27784 NEUTRAL CURRENTS. Myatt, G. (Oxford Univ.). (1973). 33p.

From international symposium on electron and photon interactions at high energies; Bonn, Germany (27 Aug 1973).

A review is given of new experimental results concerning neutral currents which have become available since the review of Perkins at the Batavia-Chicago Conference 1972. The outstanding development is that several experiments now show positive evidence for the existence of neutral currents in neutrino interactions. Also a general review is given of all data on leptonic and semileptonic neutral currents in neutrino interactions in the context of the Weinberg-Salam unified gauge theory of weak and electromagnetic interactions. (GE)

27785 HIGH ENERGY INTERACTIONS OF NEUTRINOS ON NUCLEONS AND ELECTRONS. Franzinetti, C. (Univ., Turin). (1973). 18p.

From international symposium on electron and photon interactions at high energies; Bonn, Germany (27 Aug 1973).

A report is given on the high energy neutrino beam experiments at CERN and NAL aimed at the study of neutrino interactions both on nucleons and on electrons (charged currents only). The experimental results on total cross sections and on inelastic processes as well as their theoretical interpretations are discussed. (GE)

Strong (Baryon-induced)

Refer also to abstracts 28018 and 28184.

27786 (FRNC-TH-426) IDENTIFICATION OF RELATIVISTIC PARTICLES IN WHITE STARS PRODUCED BY THE INTERACTION OF 14 GeV PROTONS IN A NUCLEAR EMULSION. Virk, H. S. (Paris-6 Univ., 75 (France)). 1972. 90p. (In French). Dep. NTIS (U. S. Sales Only) $7.50.

Thesis.

Eighty percent of the secondary particles produced in 14 GeV/c proton-nucleon interactions were identified using the center of gravity method for the multiple scattering measurements and the packet counting method for the grain density measurements. It was not possible to identify the remaining particles because of the very large track inclinations occurring. The results for some 30 white stars are summarized and comparisons made with the results of other workers at different energies: average multiplicity of the prongs of the shower produced per star; number of K mesons; mean free path; ionization and density of the grains of the tracks; momentum, mean energy and angular distribution of the pions; inelasticity coefficient. (FR)

27787 (INP-854) ANGULAR DISTRIBUTIONS IN PROTON-NUCLEUS COLLISIONS AT 67 AND 200 GeV. Babecki, J.; Czachowska, Z.; Furmanska, B.; Gierula, J.; Holynski, R.; Jurak, A.; Krzywdzinski, S.; Nowak, G.; Slezak, B.; Wolter, W. (Institute of Nuclear Physics, Krakow (Poland)). Nov 1973. 14p. Dep. NTIS (U.S. Sales Only) $4.00.

Angular distributions of particles produced in collisions of protons with the nuclei of photographic emulsion were investigated as a function of the excitation of the target nucleus. The data favor the models of elementary collisions in which particles are generated through an intermediate state. (auth)

27788 (SLAC-167(Vol. 1), pp 35-69) HADRON PRODUCTION IN THE COLLISION OF VIRTUAL PHOTONS WITH NUCLEONS: AN EXPERIMENTAL REVIEW. Perl, M. L. (Stanford Linear Accelerator Center, CA). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume I.

The review covers spacelike virtual photon kinematics-cross sections and photon polarization, theoretical orientation, the two-body channel: $\gamma + p \to \rho^0 + p$, other two-body channels, spacelike virtual photon kinematics-inclusive reactions, multiplicities and Feynman scaling, the search for virtual photon effects-transverse momentum distributions and forward charge ratios, and unanswered questions. (JFP)

27789 TOTAL AND DIFFERENTIAL CROSS SECTIONS FOR THE REACTION $\bar{p} + p \to \bar{n} + n$ AT 1.13 GeV/c. Colebourne, A. (Univ. of Liverpool); Donald, R. A.; Edwards, D. N.; Bogdanski, M.; Jeannet, E.; Gailloud, M. Nucl. Phys.; B70: No. 2, 205-214 (1974).

The reaction $\bar{p}p \to \bar{n}n$ was studied at an incident antiproton laboratory momentum of 1.13 GeV/c. The antineutron was identified through a subsequent annihilation on a proton. In all, 2601 identified events were obtained. Total and differential cross sections are presented. Comparison is made with the predictions of the Bryan and Phillips model which, in this energy range, is successful in describing the related reaction $\bar{p}p \to \bar{p}p$. Here, the agreement is less good. (auth)

27790 NUCLEAR-PASSIVE PARTICLES, WHAT ARE THEY. Erlykin, A. D.; Kulichenko, A. K.; Machavariani, S. K. Kratk. Soobshch. Fiz.; No. 8, 14-19(Aug 1973). (In Russian).

It is shown that in order to connect the energy spectra of cas-

cades in underground ionization chambers with the properties of hadron beams (on the basis of which conclusions are drawn on the existence of nuclear-passive particles) it is assumed that such particles have a normal interactive cross section but a small coefficient of elasticity. The assumption on the decay of nuclear-passive particles with time 4 to 5×10^{-11} sec does not allow the association of these phenomena. (tr-auth)

27791 STUDY OF INCLUSIVE γ AND π^0 PRODUCTION IN 12.4-GeV/c PP INTERACTIONS. Campbell, J.H.; Charlton, G.; Engelmann, R.; Glasser, R.G.; Jaeger, K.; Mann, W.A.; Oren, Y.; Peeters, P.; Whitmore, J. (Argonne National Laboratory, Argonne, Illinois 60439); Fu, C.; Rubin, H.A.; Swanson, D.; Koetke, D. Phys. Rev. D 8: No. 11, 3824-3828 (1 Dec 1973).

From an exposure of the Argonne National Laboratory 12-foot bubble chamber to a beam of 12.4-GeV/c protons we have obtained a 3649-event sample of the reaction $pp \rightarrow \gamma +$ anything, where we observe photon conversions into e^+e^- pairs in the liquid hydrogen. We find that the invariant cross section for this reaction does not separate in its x and $P_\perp$ dependence at our energy. By setting upper bounds on the cross sections for inclusive η and Σ^0 production, we show that π^0 decay is the dominant source of photons and therefore measure the cross section for inclusive π^0 production to be $\sigma(\pi^0) = (31.5 \pm 2.6)$ mb. Comparison with the inclusive π^+ and π^- cross sections at 12.0 Gev/c shows that the relation $2\sigma(\pi^0) = \sigma(\pi^+) + \sigma(\pi^-)$ is well satisfied. We confirm earlier indications that the average number of π^0's per inelastic pp interaction is approximately independent of the number of associated charged particles produced. (auth)

27792 SEARCH FOR MAGNETIC-MONOPOLE PRODUCTION BY 300-GeV PROTONS. Carrigan, R.A. Jr.; Nezrick, F.A.; Strauss, B.P. (National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 8: No. 11, 3717-3720 (1 Dec 1973).

In a search for magnetic monopoles, a steel beam dump has been exposed to 3.4×10^{16} protons of 300 GeV energy at the National Accelerator Laboratory. The search apparatus employed an 80-kG solenoid 50 cm long capable of extracting a monopole and accelerating it through a series of thin scintillation counters. A monopole would have been identified by its energy loss and range in the scintillators. No monopoles with magnetic charges in the interval from 1/6 to 24 times the Dirac magnetic charge were found. The upper limit at a 95% confidence level for the cross section per nucleon on iron is 6×10^{-42} cm^2. (auth)

27793 GENERAL CHARACTERISTICS OF DEUTERON-NUCLEAR INTERACTIONS IN PHOTOEMULSIONS AT MOMENTUM OF 9.4 GeV/c. Azimov, S. A.; Basova, E. S.; Gulyamov, U. G.; Petrov, V. I.; Chernov, G. M. (Physical-Technical Inst., Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 5, 55-58(1973). (In Russian).

The average multiplicity and angular distributions of different types of secondary particles are compared with data calculated according to the intranuclear cascade model. It is shown that experimental and calculated characteristics agree with the exception of the multiplicity of evaporated particles. (tr-auth)

27794 DEPENDENCE OF MULTIPLICITY OF SECONDARY PARTICLES ON THE ATOMIC NUMBER OF THE TARGET NUCLEUS AND ON THE ENERGY OF THE INCIDENT PARTICLE. Atanelishvili, M. I.; Berdzenishvili, O. O.; Verbetskii, Yu. G.; Garsevanishvili, L. P.; Gromov, Yu. A.; Lomtadze, T. A.; Kotlyarevskii, I. D. JETP Lett. (USSR) (Engl. Transl.); 18: No. 8, 288-290(20 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 8, 490-493(20 Oct 1973).

The growth of the multiplicity in the energy interval 50 to 3000 GeV fits satisfactorily a logarithmic law for many substances (H, CH_2, Cu). The coefficient of the logarithm increases with increasing atomic number. The data agree with the semi-inclusive scaling predictions. (auth)

27795 MULTIPLICITY DISTRIBUTION IN ANTIPROTON-PROTON INTERACTIONS. Salava, J.; Simak, V. (Inst. of Physics, Prague). Nucl. Phys.; B69: No. 1, 15-22(1974).

In a compilation of $\bar{p}p$ interactions evidence is presented for KNO scaling in the primary momentum region up to 7 GeV/c. The average multiplicity in $\bar{p}p$ interactions and annihilations has a logarithmic increase with energy. The reduced statistical momenta of multiplicity distribution $c_q = \langle n^q \rangle / \langle n \rangle^q$ are energy independent and for all final states have practically the same values as in proton-proton interactions. In annihilations the c_q appear to be different from those in $\bar{p}p$ interactions and the KNO scaling function is also different. (auth)

27796 COLLIDING POLE MODELS FOR ASYMPTOTICALLY GROWING CROSS SECTIONS AND INCLUSIVE REACTIONS. Buttimore, N. H.; Sen, S. (Trinity Coll., Dublin). Nucl. Phys.; B69: No. 1, 23-33(1974).

Colliding pole models which allow the total cross section to grow like (ln s) or $(\ln s)^2$ are used to study the qualitative features of inclusive reactions. Simple pole models lead to a breakdown of Feynman scaling and to the vanishing of the triple pomeron coupling function at t = 0. From these consequences of pole models it is concluded that J-plane cuts are necessary. (auth)

27797 STRONG INTERACTIONS AT STORAGE RING ENERGIES. Winter, K. (European Organization for Nuclear Research, Geneva). (1973). 30p. (In German).

From 37th meeting of the Deutsche Physikalische Gesellschaft; Hamburg, Germany (24 Sep 1973).

After a short description of the CERN Intersecting Storage Rings, the experiments on particle production in high energy proton–proton collisions are discussed that were performed in this installation. From the measured data for peripheral and central collisions, the properties of matter at extremely high densities can be derived and probably the existence of point-like structures within the proton. (GE)

27798 STUDY OF THE REACTIONS $\bar{p}p \rightarrow \bar{\Lambda}\Lambda$, $\bar{\Lambda}\Sigma^0$ OR $\bar{\Sigma}^0\Lambda$, $\Sigma^+\Sigma^+$ AT 3.6 GeV/c. Atherton, H. W.; French, B. R.; Moebes, J. P.; Quercigh, E. (CERN, Geneva). Nucl. Phys.; B69: No. 1, 1-14(1974).

The reactions $\bar{p}p \rightarrow \bar{\Lambda}\Lambda$, $\bar{\Lambda}\Sigma^0$ or $\bar{\Sigma}^0\Lambda$, $\bar{\Sigma}^+\Sigma^+$ are studied at an incident momentum of 3.6 GeV/c in a 35.4 event/μb experiment performed in the CERN 2m HBC. Total and differential cross sections are presented. The polarization of the hyperons is measured as a function of t and for the reaction $\bar{p}p \rightarrow \bar{\Lambda}\Lambda$ the complete spin correlation matrix is given. (auth)

27799 INVESTIGATION OF THE REACTIONS pp → pp + MESON RESONANCE AT 12 AND 24 GeV/c. Bonn-Hamburg-Munich-Collaboration. Nucl. Phys.; B69: No. 2, 237-245(1974).

The reactions pp → pp + meson, where meson = η, ρ^0, ω, and f, were investigated at P_{lab} = 12 and 24 GeV/c. Cross sections, rapidity distributions, momentum transfer and decay angular distributions are presented. Upper limits on the cross sections for $S^*(1000)$ and Φ production are given. An attempt is made to determine the dominating pairs of exchanges in the production of these resonances. (auth)

27800 TRANSVERSE MOMENTUM DEPENDENCE IN PROTON–PROTON INCLUSIVE REACTIONS AT VERY HIGH ENERGIES. Capiluppi, P. (Univ., Bologna); Giacomelli, G.; Rossi, A. M.; Vannini, G.; Bussiere, A. Nucl. Phys.; B70: No. 1, 1-38(1974).

The dependence of the invariant cross sections for proton–proton inclusive reactions at ISR energies on the c.m. transverse momentum p_T is investigated. Data were taken at fixed values of the Feynman variable x or of the laboratory rapidity y_{lab} for the range $0.15 \leq p_T \leq 1.5$ GeV/c. The shapes of the p_T distributions and the average values of the transverse momenta for $\pi^\pm$, $K^\pm$, p and $\bar{p}$ are discussed. (auth)

27801 STUDY OF THE REGGE RECURRENCE OF THE $\Delta(1236)$ PRODUCED IN 10 GeV/c K^+p INTERACTIONS. Colley, D. C. (Univ. of Birmingham, Eng.); Huq, S. S.; Jobes, M.; Kinson, J. B.; Milne, J.; Watkins, P. M.; Hughes, I. S.; McCormick, J. W. P.; Turnbull, R. M. Nucl. Phys.; B69: No. 2, 205-219(1974).

Data are presented on a high mass $I = 3/2 \Delta$ resonance produced in 10 GeV/c K^+p interactions. The mass and width of the resonance, determined by a maximum likelihood fit to the $p\pi^+$ spectrum in the final state $K^+p\pi^+\pi^-$, are 1895 ± 15 MeV/c^2 and 230 ± 50 MeV/c^2 respectively. The differential cross sections, $d\sigma/dt$, for the quasi two-body final states $K^*(890)\Delta(1236)$ and $K^*(890)\Delta(1900)$ are well described by the one pion exchange model. In addition the moments of the Gottfried-Jackson angular distribution of the $p\pi^+$ system agree with those computed from on-shell π^+p elastic scattering data. It is concluded that the two final states are produced mainly by π exchange and associate the structure observed in the moments up to NH(6,0) in the 1900 MeV region with the $3/2^+$ Regge recurrence of the $\Delta(1236)$. The dominant decay mode of the resonance is $\Delta^{++}(1900) \rightarrow p\pi^+$ but decays to $p\pi^+\pi^0$ and $n\pi^+\pi^+$ are also observed. Cross sections are determined for the production of the quasi two-body final states $K^*(890)\Delta(1236)$, $K^*(890)\Delta(1900)$, $K^*(1420)\Delta(1236)$ and $K^*(1420)\Delta(1900)$. (auth)

27802 SEARCH FOR ELECTRON PAIRS AT THE CERN ISR. Buesser, F. W. (CERN, Geneva); Camilleri, L.; Di Lella, L. Phys. Lett.; 48B: No. 4, 377-379(18 Feb 1974).

A search was made for electron pairs of large invariant mass produced in high energy proton collisions at the CERN ISR. Data are presented for a center-of-mass energy ($\sqrt{s}$) of 52.7 GeV. All electron pair candidates are believed to be consistent with background. Upper limits are obtained for the existence of massive objects decaying into electron pairs. (auth)

27803 SEARCH FOR LARGE TRANSVERSE MOMENTUM ELECTRONS AT THE CERN ISR. Buesser, F. W. (CERN, Geneva); Camilleri, L.; Di Lella, L. Phys. Lett.; 48B: No. 4, 371-376(18 Feb 1974).

At $\sqrt{s}$ = 52.7 GeV, no electron events were observed for E > 7.0 GeV where one observed event corresponds to $d^2\sigma/dE\,d\Omega = 4 \times 10^{-36}$ cm^2/(sr GeV). The observed events for 2.3 < E < 7.0 GeV are consistent with background. Upper limits to $d^2\sigma/dE\,d\Omega$ are given, and their relevance to the production of massive mesons is discussed. (auth)

27804 MEASUREMENT OF INCLUSIVE TWO-PARTICLE RAPIDITY CORRELATIONS AT THE ISR. Amendolia, S. R. (Instituto Nazionale di Fisica Nucleare, Pisa, Italy); Bellettini, G.; Braccini, P. L. Phys. Lett.; 48B: No. 4, 359-366(18 Feb 1974).

Data are presented on two-particle distributions in the approximate rapidity variable $\eta = -\ln \tan \theta/2$ for secondaries produced in proton–proton collisions at the CERN Intersecting Storage Rings (ISR). The data at center-of-mass energies of 23 and 62 GeV show the existence of energy-independent positive, short-range correlations between secondaries within the central region. Deviations from short-range correlation exist when one (or both) of the particles is near the boundary of the available phase space. In part, such deviations are interpreted as the effect of a diffractive-like component in multiparticle production. (auth)

27805 COHERENT GENERATION OF PARTICLES ON NUCLEI BY 200 GeV/c PROTONS. Alma-Ata-Leningrad-Moscow-Tashkent Collaboration. Yadern. Fiz.; 19: No. 2, 322-326(Feb 1974). (In Russian).

The cross section values are obtained for the channels with production of one, three, five and seven charged particles in the inelastic coherent interactions of protons with the photoemulsion nuclei at 200 GeV/c. The energy dependences of the cross sections of those channels and of the reaction $pA \to Ap\pi^+\pi^-$ are studied in the 20 to 200 GeV energy range. The obtained results are compared with the data on the pionic coherent reactions and with the available theoretical calculations. (auth)

Strong (Meson-induced)

27806 (CEA-N-1653) STUDY OF Y*(1385) PRODUCTION IN K$^-$p INTERACTIONS AT 4 GeV/c AND ANALYSIS OF $0^- + \frac{1}{2}^+ \to 0^- + \frac{3}{2}^+$ REACTIONS. de Brion, J.-P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 — Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). Sep 1973. 161p. (In French). Dep. NTIS (U. S. Sales Only) $11.25.

Thesis. Submitted to Paris Univ., Orsay, France.

The two prong and V^0 topology was studied in an experiment with the CERN 2m hydrogen bubble chamber at 3.93 GeV/c. The semi-automatic measuring device developed during the analysis is described. Experimental results concerning the production of $\Lambda\pi^+\pi^-$ and $\Sigma^0\pi^+\pi^-$ are presented, emphasis being given to the reaction $K^-p \to \pi^-Y^{*+}(1385)$. The formalism of the transition $0^- + \frac{1}{2}^+ \to 0^- + \frac{3}{2}^+$ is explained. The experimental results are included in a general study of this type of reaction in the framework of SU(3) symmetry and the Regge model. This analysis gives a mechanism leading to exchange degeneracy breaking. (auth)

27807 (COO-1428-328) STUDY OF THE R MESON PRODUCED IN 13 GeV/c π^+p INTERACTIONS. Thompson, G.; Gaidos, J. A.; McIlwain, R. L.; Miller, D. H.; Mulera, T. A.; Willmann, R. B. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Physics). 1973. 33p. Dep. NTIS $3.75.

The missing mass spectrum opposite the proton in a 750,000 picture exposure, 13 GeV/c π^+p bubble chamber experiment, is investigated in two and four pion channels for structures observed or denied by boson spectrometers at the same energy in the reaction $\pi^-p \to X^-p$. In the four pion final state the R^+ enhancement is observed clearly and the possibility of multi-component mass structure is considered. Treating the phenomenon as one object, cross sections and branching ratios are derived for intermediate quasi two and three body decay modes ($\omega\pi$, $\rho\rho$, $A_2\pi$, $\rho\pi\pi$). The signals in the two pion state and for the neutral state produced opposite Δ^{++} (1231) are also presented and an elasticity is calculated. (auth)

27808 (COO-1428-329) PARTIAL WAVE ANALYSIS OF THE $(\pi^+\pi^+\pi^-)$ SYSTEM THROUGH THE REGION OF THE A_3 MESON. Thompson, G.; Badewitz, R. C.; Gaidos, J. A.; McIlwain, R. L.; Paler, K.; Willmann, R. B. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Physics). 1973. 31p. Dep. NTIS $3.75.

A recent spin parity analysis of the $(\pi^+\pi^+\pi^-)$ system formed opposite a proton and a coherent deuteron by incident 13 MeV/c^2 π^+ mesons, is extended to a three pion mass of 1.9 GeV/c. Relative proportions of the contributing partial waves are presented, from threshold, and the A_3 region is discussed in detail. Contrary to results with the $(3\pi)^-$ system, a change in phase is noted for the 2^- amplitude decaying to $f^0\pi^+$ via an S-wave. The method employs the University of Illinois three body partial wave analysis program. (auth)

27809 (FRNC-TH-424) MEASUREMENT OF THE DIFFERENTIAL CROSS SECTIONS AT LARGE ANGLE OF ELASTIC SCATTERING PROCESSES π^+p AND K$^+$p AT 10 GeV/c. Savoy-Navarro, A. (Strasbourg-1 Univ., 67 (France)). 1973. 225p. (In French). Dep. NTIS (U. S. Sales Only) $14.25.

Thesis.

The differential cross sections of the $K^+p \to K^+p$ and $\pi^+p \to \pi^+p$ elastic scattering reactions were studied at 5 and 10 GeV/c throughout the entire angular range. A nonseparated π, K and proton beam was used. The measurements were effected using triggering equipment, the triggering being effected with counters and the associated fast logic. It was found that the dual absorption model gave a simple and satisfactory description of the π^+p and K$^+$p cross section structures for $t \leq 1$. Outside this range, the model does not appear to be valid at all. The exchange force model provides a good approximation for the high angle region, especially at high energies. A Pomeron-amplitude interference at high angles may be able to give a preliminary solution to intermediate angle problems. In this case, however, everything seems to be dependent on the possible structure of the Pomeron. Observations made in the region lead to new problems. Fermion Regge pole exchange seems to give a reasonable explanation of complete backward scattering (for $u \leq 1$). When $u \geq 1$ intermediate angle problems are then encountered as before. (auth)

27810 (INIS-mf-1013) REACTION $K^- + n \to K^- + \pi^- + p$. Bakker, A. M. (Amsterdam Univ. (Netherlands)). 2 Feb 1972. 144p. INIS.

An analysis of the reaction $K^- + n \to K^- + \pi^- + p$ is presented. Experimental data were obtained from an exposure of the Saclay bubble chamber filled with deuterium to a 3-GeV/c incident momentum K$^-$ beam obtained from the CERN proton synchrotron. Attention is paid to the problems encountered in extracting the mentioned neutron reaction from the deuteron reaction $K^- + d \to K^- + \pi^- + p + p_s$. Although K$\pi$ scattering experiments are impossible to carry out, the reaction $K^- + n \to K^- + \pi^- + p$, assuming π-exchange to be dominant at low neutron-proton four-momentum transfer (t_{np}), enables information to be obtained on the elastic $K^-\pi^-$ scattering by extrapolation in t_{np} to $t_{np} = \mu^2$ (μ = pion mass). Insertion of the Duerr–Pilkuhn form factors in the Chew–Low extrapolation method may be desirable. The $K^-\pi^-$ scattering in the reaction $K^- + n \to K^- + \pi^- + p$ was studied. The value of $K^-\pi^-$ elastic scattering cross section, found by extrapolation, is small, on the average 2 mb in the region from threshold up to 1.2 GeV $K^-\pi^-$ center of mass energy. An attempt was made to measure the s- and p-wave phase shifts of the $K^-\pi^-$ scattering. Although data do not permit an accurate determination, the p-wave phase shift is found to be consistent with zero up to 1.1 GeV and the absolute value of the s-wave phase shift is found to increase slowly from ~5° in the threshold region up to ~15° at 1.1 GeV. Data on the reaction $K^- + n \to K^- + \pi^- + p$ at 3 GeV/c, and also those obtained by other experimentalists at 5.5 and 12.6 GeV/c incident momenta, are compared with a model which contains pion and pomeron exchange. In the amplitudes for these two processes the $K^-\pi^-$ scattering and the pomeron-neutron interaction are described by Veneziano (four-point) amplitudes and combined with a kind of "reggeized" pion and pomeron exchange respectively. The model gives a reasonably good description of the data of all three experiments. (auth)

27811 (INIS-mf-1115) DOUBLE RESONANCE PRODUCTION IN 5 GeV/c π^+p REACTIONS. Pols, C. L. A. (Katholieke Universiteit Nijmegen (Netherlands). Fysisch Lab.). 1972. 167p. (In Dutch). INIS.

A 5 GeV/c π^+p bubble chamber experiment was performed by collaboration of five laboratories (Bonn, Durham, Nijmegen, Paris, Turin). The following reactions with double resonance production were observed in channels with four charged particles in the final state: $\pi^+p \to \Delta^{2+}\rho^0$ (or f^0) in the channel $p\pi^+\pi^+\pi^-$ and $\pi^+p \to \Delta^{2+}\omega^0$ (or η^0) in the channel $p\pi^+\pi^+\pi^-\pi^0$. The cross-sections for the reaction channels and the double resonance production are given. The latter ones are determined by fitting a distribution function to the two-dimensional Goldhaber plots. The decay angular distributions are described using the joint-decay spin density matrix and the statistical tensors. The results obtained for the reactions $\Delta^{2+}\rho^0$ and $\Delta^{2+}\omega^0$ are compared with theoretical models. (LBS)

27812 TRANSVERSE SPECTRA IN π^+p AND K$^-$p INTERACTIONS BETWEEN 8 AND 16 GeV/c. Aachen-Berlin-Bonn-CERN-Krakow-Heidelberg-London-Vienna-Warsaw Collaboration. Nucl. Phys.; B70: No. 2, 189-204(1974).

Using data from several bubble chamber experiments, the in-

clusive reactions $\pi^+ p \to \pi^- + X$, $K^- p \to K^0 + X$ and $K^- p \to \Lambda + X$ were studied at incident momenta ranging from 8 to 16 GeV/c. Single particle spectra are given as functions of the transverse energy $E_\perp = (p_\perp^2 + m^2)^{\frac{1}{2}}$ for selected intervals of the longitudinal rapidity y. Using these two variables a simple, mass independent, representation of all particle spectra was found. Within a large range of y, non-Lorentz-invariant $E_\perp$ distributions are nearly exponential and, over several orders of magnitude in cross section, can be fitted well with the single-parameter function $(e^{E_\perp/T}-1)^{-1}$. The slope parameter T is shown to depend on y but, in the central region, it appears to be independent of the particle mass and gives indications of approaching a limiting value of approximately 120 MeV. Implications of these results with regard to thermodynamic models are briefly discussed. (auth)

27813 NEUTRON TO PROTON RATIO ON THE SURFACE OF NUCLEI. Gupta, S. C.; Mangotra, L. K.; Prakash, Y.; Rao, N. K.; Sharma, M. L.; Singh, T. (Jammu Univ., India). Nucl. Phys.; B70: No. 3, 414-424(1974).

About 13,800 K^- captures in emulsion nuclei are studied to determine the (neutron/proton) ratio on the surface of nuclei. All events with one or two black and grey prongs (N_h = 1 or 2) are analyzed. The events are classified into $\Sigma^\pm\pi^\mp$ and Σ^-, no pion. The ratio $(K^-n/K^-p)_{heavy}/(K^-n/K^-p)_{light}$ is found to be 2.9 ± 0.3. The ratio $S = (\Sigma^+\pi^-/\Sigma^-\pi^+)$ in heavy and light nuclei is found to be 1.3 ± 0.2 and 0.6 ± 0.1 respectively. (auth)

27814 STUDY OF THE η MESON FROM THE REACTION $K^- p \to \Lambda\eta'$ AT 2.18 GeV/c. Danburg, J.S.; Kalbfleisch, G.R.; Borenstein, S.R.; Strand, R.C.; VanderBurg, V. (Brookhaven National Laboratory, Upton, New York 11973); Chapman, J.W.; Kiang, R.K.; Lys, J. Phys. Rev. D 8: No. 11, 3744-3765 (1 Dec 1973).

We present new data on the η meson based on 1414 η events obtained from a 1100000-picture exposure of the BNL 31-inch hydrogen bubble chamber to a 2.18-Gev/c K^- beam. We have measured the η mass, width, and branching ratios. We find that the very forward produced η mesons have anisotropic angular distributions with respect to the incident K^- beam, suggesting that possibly $J^{PC} = 2^{-+}$; however, the standard Dalitz-plot analyses favor $J^{PC} = 0^{++}$ over 2^{-+}. (auth)

27815 STUDY OF THE R-MESON WITH A MISSING MASS SPECTROMETER. Moromisato, J. H. Boston; Northeastern Univ. (1972). 171). University Microfilms Order No. 73-28,836. Thesis (Ph. D.).

An experiment is described which studied the reaction using $\pi^- + p \to p + X^-$ the missing mass technique, at an incident beam energy of 8 GeV. The direction of the recoil proton was determine mined by five wire spark chambers with magnetostrictive read out, while its kinetic energy was measured by five large scintillation counter telescopes. The mass resolution obtained was 21 ± 2 MeV FWHM. About 8×10^3 events above background were detected at the R-region (1650 MeV). The shape of the R enhancement is well explained by a single relativistic Breit Wigner function, $P(\chi^2) = 38\%$. While fits to the data with three narrow resonances, with the parameters reported by the CERN Missing Mass Spectrometer (CMMS) group, give low χ^2 probability: $P(\chi^2) \sim 3\%$ for $\Gamma_{R_i} \approx 30$ MeV, and $P(\chi^2) < 10^{-7}$ for $\Gamma_{R_i} = 0$ MeV. A S enhancement is also seen in the data, which is very sensitive to the choice of background, and whose mass, width and cross sections, could be compatible with the values reported by the CMMS group. Order No. 73-28,836, 171 pages. (Diss. Abstr. Int., B)

27816 INCLUSIVE REACTIONS FROM $\pi^+ p$ AT 4.1 GeV/c. Fong, D.G.; Shapiro, A.M.; Widgoff, M. (Department of Physics, Brown University, Providence, Rhode Island 02912). Phys. Rev. D 8: No. 11, 3765-3773 (1 Dec 1973).

At a π^+ beam momentum of 4.1 GeV/c, in reactions of the type $a + b \to c + X$, limiting fragmentation of the beam and target particles is observed where abc̄ is exotic, and is not observed for abc̄ not exotic. Single-particle distributions in several different variables have been studied for π^- and π^+ mesons. The two-particle distributions and correlation functions from the reaction $\pi^+ + p \to \pi^- + \pi^- + X$ are also presented. (auth)

27817 CONSISTENCY OF NEW MESON-NUCLEON ELASTIC SCATTERING DATA WITH A PREVIOUSLY CONJECTURED UNIVERSAL CURVE. Blaha, S.; Sukhatme, U.P. (Physics Department, University of Washington, Seattle, Washington 98195). Phys. Rev. D 8: No. 11, 4221-4222 (1 Dec 1973).

We show that important new large-t $\pi^- p$ data at P_L = 13.8 and 22.6 GeV/c are in good agreement with a universal curve suggested last year. (auth)

27818 STUDY OF THE REACTION $\pi^+ n \to p\pi^0\pi^0$ AT 2.1 GeV/c. Braun, K.J.; Cline, D.B. (University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. D 8: No. 11, 3794-3807 (1 Dec 1973).

Using the reaction $\pi^+ d \to pp$ (MM) at 2.13 GeV/c with photons from the final-state π^0's detected by tantalum plates in the 30-in. ANL bubble chamber, a $2\pi^0$ mass spectrum has been obtained in several ways. This spectrum is found to be in good agreement with phase-space expectations and presents no evidence for the production of a "narrow" ϵ ($\Gamma < 200$ MeV). The $2\pi^0$ cross section for $\Delta^2 < 15\mu^2$ is 386 ± 80 μb. $\pi\pi$ production and scattering angular distributions are presented. Good agreement with the one-pion-exchange model is noted. Assuming that the ratios of peripheral pion-production cross sections are equal to their pole values, a new method for extracting $\pi\pi$ scattering parameters is discussed. Using this method the I = 0 s-wave phase shift is uniquely determined from threshold to 1 GeV/c² and found to be similar to the so-called UP-DOWN solutions of s-p wave interference analyses. In addition, the ratios of I = 0 to I = 2 s-wave scattering phase shifts and scattering lengths are found to be equal to $-(3.2^{+1.5}_{-1.0})$ near $\pi\pi$ threshold. Using a dispersion sum rule, the $\pi\pi$ scattering lengths are found to be $a_0 = +(0.15 \pm 0.08)\ \mu^{-1}$ and $a_2 = -(0.05 \pm 0.01)\ \mu^{-1}$. (auth)

27819 DIFFERENTIAL CROSS SECTIONS IN $\pi^- p \to K^0\Lambda^0$ AND $\pi^- p \to K^0\Sigma^0$ FROM 3 TO 6 GeV/c. Ward, C.E.W.; Ambats, I.; Lesnik, A.; Meyer, W.T.; Rust, D.R.; Yovanovitch, D.D. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 31: No. 18, 1149-1152 (29 Oct 1973).

We have measured the differential cross sections for the associated-production reactions $\pi^- p \to K^0\Lambda^0$ and $\pi^- p \to K^0\Sigma^0$ at 3, 4, 5, and 6 GeV/c, with a total of over 40 000 events. We find that both reactions have exponential forward peaks for $-t \lesssim 0.4$ (GeV/c)², with no indication of forward-direction flattening or turnover; the slopes of the forward peaks show little if any variation with momentum; and the two cross sections are equal within experimental error from $-t = 1.2$ (GeV/c)² out to at least $-t = 2.0$ (GeV/c)². (auth)

27820 HIGH ENERGY PHYSICS USING TOTAL ABSORPTION DETECTORS. Hofstadter, R. (Stanford Univ., CA). Kakuriken Kenkyu Hokoku; 5: 511-525(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendei, Japan (12 Sep 1972). See CONF-720907-.

The reactions $\pi^+ + p \to \pi^0 +$ anything, $\pi^0 \to 2\gamma$ and $\pi^- + p \to \pi^0 +$ anything, $\pi^0 \to 2\gamma$ at 14 MeV were studied using total absorption detectors. The gamma mass spectrum and the cross sections were found. (JFP)

27821 REACTIONS $\pi^\pm p \to pX^\pm$ (900-1020 MeV) NEAR THRESHOLD. Kalbfleisch, G. R. (Brookhaven National Lab., Upton, NY); Vanderburg, V.; Alspector, J.; Cohen, K. J.; Harrison, W. C.; Oostens, J.; Ankenbrandt, C. M. Nucl. Phys.; B69: No. 2, 279-284(1974).

No structure was observed in the $X^\pm$ spectra as narrow as a mass resolution of 12 MeV FWHM. Thus the $X^0(957)$ of Binnie et al., is determined to be the I = 0 η'. A broad structure at a mass of 976 MeV can be accommodated. (auth)

27822 STUDY OF THE R MESON PRODUCED IN 13 GeV/c $\pi^+ p$ INTERACTIONS. Thompson, G.; Gaidos, J. A.; McIlwain, R. L.; Miller, D. H.; Mulera, T. A.; Willman, R. B. (Purdue Univ., Lafayette, IN). Nucl. Phys.; B69: No. 2, 220-236(1974).

The missing mass spectrum opposite the proton in a 750,000 picture exposure, 13 GeV/c $\pi^+ p$ bubble chamber experiment, is investigated in two and four pion channels for structures observed or denied by boson spectrometers at the same energy in the reaction $\pi^- p \to X^- p$. In the four pion final state the R^+ enhancement is observed clearly and the possibility of multi-component mass structure is considered. Treating the phenomenon as one object, cross sections and branching ratios are derived for intermediate quasi two and three body decay modes ($\omega\pi$, $\rho\rho$, $A_2\pi$, $\rho\pi\pi$). The signals in the two pion state and for the neutral state produced opposite $\Delta^{++}(1231)$ are also presented and an elasticity is calculated. (auth)

27823 STUDY OF THE REACTIONS $\bar{K}N \to \Sigma(1385)\pi$ BETWEEN 0.6 AND 1.2 GeV/c. CERN-Heidelberg-Saclay-Collaboration. Nucl. Phys.; B69: No. 2, 246-265(1974).

An energy-dependent partial-wave analysis of the reaction $\bar{K}N \to \Sigma(1385)\pi$ was performed in the energy region lying between 1.65 and 1.85 GeV. The resonant amplitudes of seven well known Y^* resonances were determined, and used to compute the corresponding (8) × (10) SU(3) coupling constants. (auth)

27824 STUDY OF $\pi^-\pi^-$ SCATTERING FROM $\pi^- p$ INTERACTIONS AT 3.93 GeV/c. Losty, M. J. (CERN, Geneva); Chaloupka, V.; Ferrando, A.; Montanet, L.; Paul, E.; Yaffe, D.; Zieminski, A.; Alitti, J.; Gandois, B.; Louie, J. Nucl. Phys.; B69: No. 1, 185-204(1974).

A modified Chew-Low extrapolation procedure is applied to the reaction $\pi^- p \to \Delta^{++}\pi^-\pi^-$ to extract the I = 2π elastic cross sections from threshold to 1260 MeV. The predictions of the one-pion-exchange model are used to estimate the contributions from

background processes of the type $\pi^- p \rightarrow \Delta^0 \rho^0$. The moments of the $\pi^-\pi^-$ angular distribution are also extrapolated to the pion pole and a phase shift analysis performed. The s-wave inelasticity is constrained using information on the inelastic cross section coming from six-body final states. The magnitude of the s-wave phase shift at the K^0 mass is found to be $7.2 \pm 1.0°$, increasing to $26.2 \pm 2.5°$ at 1 GeV. d- and g-waves contribute above about 900 MeV, but the corresponding phase shifts are small compared with the s-wave. All three phase shifts have the same sign. (auth)

27825 STRUCTURE IN THE REACTION $\pi^+ p \rightarrow \Delta^{++}\rho^0$ AT 5 GeV/c. Eisenberg, Y.; Haber, B.; Karshon, U.; Mikenberg, J.; Pitluck, S.; Ronat, E. E.; Shapira, A.; Yekutieli, G. (Weizmann Inst. of Science, Rehovot, Israel). Phys. Lett.; 48B: No. 4, 354-358(18 Feb 1974).

In a high statistics experiment a large $d\sigma/dt'$ slope of (23.7 ± 3.2) GeV^{-2} is obtained in the forward direction. The natural parity exchange cross section shows a dip at $t' \approx 0.2$ GeV^2 and peak at ≈ 0.6 GeV^2. The ρ^0 is separated from the S-wave background and one obtains $\rho^1_{00} \approx 0.94$, at $t' = 0$. (auth)

27826 MEASUREMENT OF ELASTIC PION–PROTON SCATTERING AT 50 GeV. Derevchekov, A. A. (Inst. for High Energy Physics, Serpukhov, USSR); Golovin, N. I.; Khodirev, Y. C. Phys. Lett.; 48B: No. 4, 367-370(18 Feb 1974).

Elastic pion-proton scattering was measured in a 50 GeV/c π^- beam at the 76 GeV proton synchrotron in Serpukhov. Data are presented for four-momenta transfer squared in the range $0.03 < t < 0.4$ (GeV/c)^2. (auth)

27827 MEASUREMENT OF THE FOUR-PION DECAY OF THE $f^0(1270)$ MESON. Louie, J. (CEN, Saclay, France); Alitti, J.; Gandois, B. Phys. Lett.; 48B: No. 4, 385-387(18 Feb 1974).

New evidence is presented for the decay $f^0 \rightarrow \pi^+\pi^+\pi^-\pi^-$ from π^-p interactions at 3.93 GeV/c. The branching ratio $f^0 \rightarrow \pi^+\pi^+\pi^-\pi^-/f^0 \rightarrow \pi^+\pi^-$ is determined to be $(6.5^{+}_{-}{}^{?}_{?})\%$. (auth)

27828 DETERMINATION OF THE EFFECTIVE B AND ρ TRAJECTORIES FROM THE REACTION $\pi^+ p \rightarrow \omega\Delta^{++}$. Buhl, W. F.; Gidal, G.; Grether, D. F.; Ko, W.; Alston-Garnjost, M.; Barbaro-Galtieri, A.; Lynch, G. R.; Somitz, F. T. (Univ. of California, Berkeley). Phys. Lett.; 48B: No. 4, 388-392(18 Feb 1974).

Results of two high statistics bubble chamber measurements of the reaction $\pi^+ p \rightarrow \omega^0\Delta^{++}$ at incident momenta of 2.67 and 7.1 GeV/c are presented. The energy dependence of the natural parity exchange projection gives a Regge trajectory consistent with the accepted ρ trajectory. The unnatural parity exchange projection gives a B trajectory consistent with current knowledge of the pion trajectory. (auth)

27829 MASS ESTIMATES OF HEAVY HYPERFRAGMENTS DECAYING NON-MESONICALLY. Mondal, A. S.; Basak, A. K.; Kasim, M. M.; Husain, A. (Rajshahi Univ., India). Nucl. Sci. Appl., Ser. B; 6: 9-13(Oct 1973).

Masses of 8 heavy hyperfragments, selected on the basis of the visible energy, Evis > 100 MeV and apparent momentum imbalance > 250 MeV/c of the decay particles, were estimated from decay star analysis. The hyperfragments are found to be in mass range $40 \leq A \leq 90$. Mass estimations were also made from the production star analysis by assuming the validity of the "spallation model" for the production of such hyperfragments. The lower limits of hyperfragment masses obtained from the decay star analysis are found consistent with the masses obtained from the production star, justifying the use of spallation model in finding the mass of heavy hyperfragments. (auth)

27830 PERIPHERAL PRODUCTION OF SOME RESONANT STATES FROM INELASTIC COLLISION OF 5 GeV/c K^+ ON PROTON. Huq, S. S. (Rajshahi Univ., India). Nucl. Sci. Appl., Ser. B; 6: 51-55(Oct 1973).

Evidence for the production of K* (892), N* (1236), K* (1400), and ρ^0 (730) resonant states investigated from effective mass distribution of the final state particles K^+, π^+, π^- and p produced from collision of 5 GeV/c K^+ on protons is presented. Quasi-two body processes $K^+p \rightarrow K^*(892)$ N* (1236) and $K^+p \rightarrow K^*$ (1400) N* (1236) are very apparent in the reaction $K^+p \rightarrow K^+\pi^+\pi^-p$. These resonant states are produced very peripherally as is evident from sharply peaked forward and backward c.m. production angular distribution of these resonant states in over all c.m. system. The Δ^2 (four momentum transfer squared) distributions from the incident K^+ to K* (892) and K* (1400) resonant states and from the target proton to N* (1236) resonant states peaked at very low value give very strong indication of the peripheral production of these resonant states. (auth)

27831 DOUBLE STRANGE EXCHANGE OF K^- MESONS OF A MOMENTUM OF 1.5 BeV/c IN NUCLEAR EMULSION. Todorovic, Z.; Juric, M. (Inst. of Physics, Belgrade). Fizika (Zagreb); 5: No. 4, 187-194(Dec 1973).

An analysis was made of processes of double strange exchange of K^- mesons leading to the production of hyperfragments together with strange particles. The process of double strange exchange of K^- mesons on nuclei (with the formation of two hyperons of strangeness $S = -1$ in the final state) is brought about through a secondary interaction of Ξ hyperons or π mesons with nucleons in the nucleus in which they are produced. The contribution of individual channels in the production of events with a hyperfragment and strange particles is discussed. (auth)

27832 $K^-n \rightarrow \Sigma^-\eta$ NEAR THRESHOLD. Chu, R. Y. L. (State Univ. of New York, Plattsburgh); Bartley, J.; Dowd, R.; Schneps, J.; Tompkins, J.; Wolsky, G.; Kirsch, L.; Schmidt, P. Nuovo Cim.; 20A: No. 1, 35-48(1 Mar 1974).

The reaction $K^-n \rightarrow \Sigma^-\eta$ was studied near threshold. The production angular distribution and the cross section as a function of energy were measured. The combined angular distributions of this experiment and two previous ones suggest that a $J = 1/2$ amplitude dominates in $\Sigma^-\eta$ production. The cross section can be fitted with a $\Sigma^-\eta$ resonance of mass 1785 ± 12 and width 89 ± 33, or it can be fitted in a zero–effective-range scattering approximation with a scattering length of $(0.92 \pm 0.12) \pm i(0.04 \pm 0.28)$ fm. (auth)

27833 PAIRING CORRELATIONS OF PROTONS IN PION–CARBON INTERACTIONS AT 4.0 AND 7.5 GeV/c. Azimov, S. A.; Azimova, M.; Igamberdiev, K. R.; Lutfullaev, S. L.; Rizaev, Kh. A.; Yuldashev, A. A.; Yuldashev, B. S. (Inst. of Physics, Kiev). Yadern. Fiz.; 19: No. 2, 317-321(Feb 1974). (In Russian).

A narrow peak in the vicinity of the sum of the mass at rest is observed in the effective mass spectra of the two protons from the reaction $\pi^- + {}^{12}C \rightarrow 2p +$ anything at 4.0 and 7.5 GeV/c. The experimental data are well fitted by the theory of nucleon interaction in the final state. (auth)

27834 LOW-MASS PART OF THE $(K\pi\pi)$ SYSTEM IN THE REACTION $K^-p \rightarrow K^-p\pi^+\pi^-$ AT 8.25 GeV/c. Angelopoulos, A. (Univ., Athens); Apostolakis, A.; Michaelidis, P.; Stergiou, A.; Theocharopoulos, P.; Filippas, T. A.; Simopoulou, E.; Tsilimigras, P.; Vayaki, A.; Zevgolatakos, E.; Brankin, C.; Fry, J. R.; Matthews, R.; Muirhead, H.; Dallman, D.; Markytan, M.; Otter, G.; Schmid, P.; Strauss, J. Nuovo Cim., 20A: No. 1, 49-71 (1 Mar 1974).

The low-mass $(K\pi\pi)$ system of the reaction $K^-p \rightarrow K^-p\pi^+\pi^-$ at 8.25 GeV/c is studied. The cross section of this reaction is (0.97 ± 0.04) mb. The dependence of the cross section on the proton–proton momentum transfer shows broadening of the diffraction peak with respect to increasing $(K\pi\pi)$ mass. The production of two-body and three-body resonances is discussed with respect to their occurrence in the four longitudinal-momentum phase space sectors of $p_l(\pi^+)$ vs. $p_l(\pi^-)$. This allows one to separate the three-body low-mass systems $(K\pi\pi)$ and $(p\pi\pi)$, which can be produced diffractively, from the other quasi-two-body processes whose production mechanism is meson exchange. In order to discuss what spin-parity contributions can be distinguished in the low-mass $(K\pi\pi)$ system, the D-moments of the angular distributions of the $(K\pi\pi)$ system with respect to variation of its effective mass and to variation of the possible analyzer directions are carried out. The result is that, in addition to the dominant $J^P = 1^+$ content, there is a clearly identifiable $J^P = 0^-$ contribution to the low-mass $(K\pi\pi)$ system. This contribution can be estimated to be 10% by an analysis of the density of events in the Dalitz plot, which gives also that the ρ production amplitude with respect to the K*(890) production amplitude decreases with increasing $(K\pi\pi)$ mass. This result is in agreement with an analysis of the reaction $K^+p \rightarrow K^+p\pi^+\pi^-$. The properties of the D-moments and their predictability or suppression with respect to various spin-parity contributions are given. (auth)

Particle Interactions and Properties (Theoretical)

General

27835 (JINR-E2-7711) RELATIVISTIC MULTIPARTICLE KINEMATICS IN INVARIANT VARIABLES. Gheorghe, A.; Ion, D. B.; Mihul, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. Dep. NTIS (U. S. Sales Only) $4.00.

A complete system of algebraic constraints on the Gram matrices of four-momenta and an analytic reconstruction of any

finite set of four-momenta from their Gram matrix are established. The physical regions and phase-space volume elements in general invariant variables of both exclusive and inclusive multiparticle processes are also given. (auth)

27836 (JINR-P2-7676) CRITICAL COMMENTS ON THE TWO-COMPONENT MODELS OF MULTIPLE GENERATION. Dushutin, N. K.; Maltsev, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 8p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

It is shown that the behavior of the 3rd and the 4th correlation parameters, which was obtained in the two-component model for the processes of multiple production, does not agree with experimental data. (auth)

27837 (SLAC-167(Vol.1)) PROCEEDINGS OF SUMMER INSTITUTE ON PARTICLE PHYSICS, JULY 9–28, 1973. Volume I. Deep Inelastic Electroproduction. (Stanford Linear Accelerator Center, Calif. (USA)). Nov 1973. Contract AT(04-3)-515. 371p. Dep. NTIS $10.60.

The conference included 21 papers, one of which was abstracted previously in NSA as 29: 6132. Separate abstracts were prepared for 20 papers. (JFP)

For abstracts of individual papers see: 27747–27754, 27771, 27772, 27788, 27838, 27869–27872, 27923–27925, and 27947.

27838 (SLAC-167(Vol. 1), pp 239-253) QUARKS, PARTONS, TRIALITY, EXOTICS, AND COLORED GLUE. Lipkin, H. J. (National Accelerator Lab., Batavia, IL). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9–28, 1973. Volume I.

The three puzzles of the quark model: triality, exotics, and diquark or meson–baryon are discussed in detail. An important conclusion is that of the crucial role played by repulsive forces and the extra color degree of freedom in finding answers to these puzzles. (JFP)

27839 (SLAC-167(Vol. 2)) PROCEEDINGS OF SUMMER INSTITUTE ON PARTICLE PHYSICS, JULY 9–28, 1973. Volume II. Weak Currents and Interactions. (Stanford Linear Accelerator Center, Calif. (USA)). Nov 1973. Contract AT(04-3)-515. 284p. Dep. NTIS $7.60.

Separate abstracts were prepared for each of the 15 lectures included. (JFP)

For abstracts of individual lectures see: 27773–27778, 27840–27842, 27873, 27926, 27948, 28048, 28551, and 28552.

27840 (SLAC-167(Vol.2), pp 1-22) CURRENT ALGEBRA AND PCAC. Drell, S. D. (Stanford Linear Accelerator Center, CA). Nov 1973.

In Proceedings of Summer Institute on Particle Physics, July 9–28, 1973. Volume II.

The topics discussed include current algebra universality, PCAC, the Adler–Weisberger relation (charge algebra), Cabibbo angle, K_{l3} decay, Adler sum rule for ν scattering (local charge density algebra) nonscaling, almost equal time commutators weak PCAC tests, and Schwinger terms. (JFP)

27841 (SLAC-167(Vol.2), pp 119-128) HOW TO TRANSFORM CURRENT QUARKS TO CONSTITUENT QUARKS AND TRY TO PREDICT HADRON DECAYS. Kugler, M. (Stanford Linear Accelerator Center, CA). Nov 1973.

In Proceedings of Summer Institute on Particle Physics, July 9–28, 1973. Volume II.

A lecture is given on a review of the development of physical ideas and results rather than technical details of the calculations for the quark model. The subject is reviewed historically, then the transformation due to Melosh and the algebraic properties that can be abstracted from it are discussed. A comparison is made of the phenomenological predictions of the theory with experiment, and some future problems are outlined. (JFP)

27842 (SLAC-167(Vol.2), pp 225-234) GAUGE THEORIES AS PARTON MODELS. Quinn, H. R. (Harvard Univ., Cambridge, MA). Nov 1973.

In Proceedings of Summer Institute on Particle Physics, July 9–28, 1973. Volume II.

The results of the application of parton-model ideas to various gauge models for hadronic weak interactions are discussed in order to find experimentally accessible tests that can distinguish between the many possible gauge models. The considered tests require high energy neutrino and antineutrino cross sections for proton and neutron targets separately. (JFP)

27843 CONSTRAINTS FULFILLED BY DENSITY MOMENTS AND DENSITY CORRELATIONS. Koba, Z. (Univ. of Copenhagen); Weingarten, D. Nucl. Phys.; B70: No. 3, 534-544(1974).

The first set of equations considered follow from the conservation of additive quantum numbers. These constraints assume a simpler form than the corresponding relations for inclusive cross sections and inclusive correlations and can all be fulfilled consistently with any collection of higher order density correlation functions $G_m(x,k_{il},\nu_1,\ldots,x_m,k_{im},\nu_m)$, $m \geq 2$, identically zero. A set of constraints are also derived from the requirements that the probability of any particular class of final states must be a number greater than or equal to zero, and the number of particles of a certain type which appear in any region of momentum space must also be positive or zero. These relations can be fulfilled with any finite sequence of density correlations $G_m(x_l,k_{il},\nu_l,\ldots,x_m,k_{im},\nu_m)$, $m \geq 3$, identically equal to zero, or with all correlations of order $m \geq 2$ identically zero. (auth)

27844 ISOSPIN SUM RULES AND DISCONTINUITY FORMULAE FOR INCLUSIVE REACTIONS. Dondi, P. H.; Macfarlane, A. J. (Cambridge Univ., Eng.). Nucl. Phys.; B70: No. 3, 437-444(1974).

A functional method of deriving families of sum rules that express the full content of isospin conservation is described. In particular, it is shown that there seem to be no isospin relations involving inclusive cross sections beyond those that follow from I_z conservation alone. (auth)

27845 METHOD OF CALCULATION OF THE S-MATRIX ELEMENTS FOR A REACTION WITH ARBITRARY POLARIZED ELECTRONS. Perov, Yu. S. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 115-118(1973). (In Russian).

A method is proposed for the calculation of S-matrix elements. It is based on a specialized form of the writing of electron and positron wave functions. The product, introduced in the matrix element, of the amplitude of a particle pair is expanded according to the Dirac matrix and the matrix trace is calculated. Some properties of the magnitudes introduced in the expansion coefficient are examined. (tr-auth)

27846 HIGH-ENERGY PHYSICS 25 YEARS AFTER THE DISCOVERY OF THE π MESON. Van Hove, L. (CERN, Geneva). Postepy Fiz.; 24: No. 6, 579-611(1973). (In Polish).

The discussion is based on lectures given at the Physical Societies of Zurich, Belgium and the Netherlands, and on a lecture series at the Max-Planck-Institute for Physics and Astrophysics, Munich. It compares the state of high-energy physics in 1947 and 1972, reviews some of the most important developments in this period, and ends by listing a few current and future problems. (auth)

27847 TACHYON QUANTIZATION. Streit, L. (Syracuse Univ., NY); Klauder, J. R. Lect. Theor. Phys.; 14B: 539-550 (1973).

Tachyons quantizations are obtained by constructing representations of the tachyon commutation relations. These are causal: field operators at spacelike separation will commute with each other. The construction proceeds from an ansatz for the two-point function. Consistent causal Poincare invariant quantizations of the free tachyon field are obtained in a systematic way. (JFP)

27848 BAXTER'S QUANTUM NUMBER IN THE XY MODEL. Jones, R. B. (Queen Mary Coll., London). J. Phys., A (London); 7: No. 2, 280-288(21 Jan 1974).

In the particular case of the asymmetric XY model an explicit form for the operator corresponding to Baxter's quantum number n is obtained. It is shown that this operator is closely associated with a transformation of spin operators which converts the asymmetric XY Hamiltonian into a symmetric XY Hamiltonian with alternating nearest-neighbor interactions. (auth)

27849 ATOMI. Yadra. Chastinki. (Atoms, Nuclei, Particles). Davidov, O. S. Kiev; Vidavnitstvo Naukova Dumka (1973). 213p.

The properties of atoms, nuclei, and particles are discussed. Nuclear reactions and the basic interactions in nature are outlined. The characteristics of light elementary particles are considered. Baryons and mesons are discussed. New classifications of elementary particles are given. (JSR)

27850 QUANTUM MECHANICS OF DISSIPATIVE LAGRANGIANS. Papadopoulos, G. J. (Leeds Univ., Eng.). J. Phys., A (London); 7: No. 2, 209-212(21 Jan 1974).

An appropriate path differential measure is employed for obtaining the path integral representation of the propagator of a particle with a time dependent "mass". The evaluations are restricted to quadratic lagrangians and the propagator for the damped harmonic oscillator is given explicitly. (auth)

27851 HIGGS EFFECT FOR GOLDSTONE PARTICLES WITH SPIN ½. Volkov, D. V.; Soroka, V. A. (Physical-Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.); 18: No. 8, 312-314(20 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 8, 529-532(20 Oct 1973).

The introduction of gauge fields and the Higgs effect for Goldstone particles with spin ½ are considered. (auth)

27852 UNCERTAINTY RELATION IN THE COHERENT SPIN-STATE REPRESENTATION. Kolodziejczyk, L.; Ryter, A. (Univ., Lodz, Poland). J. Phys., A (London); 7: No. 2, 213-215(21 Jan 1974).

The product $(\delta S_x)^2(\delta S_y)^2$ is computed where $(\delta S_{x,y})^2 = \langle S^2_{x,y}\rangle - \langle S_{x,y}\rangle^2$; averaging is performed in the coherent spin-state representation given by Radcliffe (J. Phys. A, Gen. Phys.; 4: 313(1971)). After applying the Holstein-Primakoff transformation $\hat{S}_- = (2S)^{\frac{1}{2}}\hat{a}^+$, $\hat{S}_+ = (2S)^{\frac{1}{2}}\hat{a}$ and $\mu = \alpha/(2S)^{\frac{1}{2}}$, and putting $S \to \infty$ one can proceed from Radcliffe space into the Glauber space. After this procedure the product $(\delta S_x)^2(\delta S_y)^2$ becomes $(\delta_x)^2(\delta_y)^2$. Using the Jackiw equation (J. Math. Phys. 9; 339 (1968)) it is shown that the function $|\mu = 0\rangle$ is the only one which minimizes the uncertainty product, for every S. (auth)

27853 INFLUENCE OF THE POMERON STRUCTURE ON TRIPLE-POMERON COUPLING. Alonso, J. L.; Schiff, D. (Paris Univ., Saclay, France). Nucl. Phys.; B70: No. 1, 125-132(1974).

The objection raised by Halliday and Sachrajda against the inclusive sum-rule proof of the vanishing of the triple-Pomeron coupling at zero momentum transfer is discussed. It is shown that the graph which they have examined yields a negative divergent (when $s \to \infty$) contribution to the inclusive cross section. Consideration of an infinite sum of graphs is necessary in order to complete this proof. (auth)

27854 UNITARITY CONSTRAINTS FOR FOUR- AND SIX-POINT FUNCTIONS. Muetter, K. H. (Univ., Heidelberg). Nucl. Phys.; B69: No. 2, 372-380(1974).

The unitarity sum-rules, which relate the four- and sixpoint functions in the nonforward directions are analyzed in terms of partial-wave amplitudes. Two applications of the unitarity sum rules are discussed. First, bounds on the one particle inclusive cross sections are derived, in terms of the absorptive part of the four point function. Then the unitarity sum rules are evaluated in a pole approximation for the six-point function and it is found that the trilinear coupling of a scalar particle with mass μ has to vanish at least quadratically for $\mu \to 0$, if the diffraction peak does not shrink. (auth)

27855 ASYMPTOTICAL EQUALITY OF AVERAGED MULTIPLICITIES OF PARTICLES IN CROSSED INCLUSIVE REACTIONS. Gershtein, S. S.; Logunov, A. A.; Mestvirishvili, M. A. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 18: No. 3, 339-341(Mar 1974). (In Russian).

Asymptotical (at high energies) equality of averaged multiplicities of particles in crossed and charge-conjugated inclusive reactions is established. (auth)

27856 HIGH ENERGY PHYSICS INDEX. Volume 12, Nos. 1-2, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 93p.

27857 UNITARITY SUM RULES AND THE TWO-REGGEON CUT. Veneziano, G. (CERN, Geneva). Nucl. Phys.; B69: No. 2, 317-324(1974).

Using (s-channel) unitarity sum rules, consistency requirements on the two-reggeon cut are derived. A consistent solution is found with the (negative) absorptive sign of the cut, and its magnitude is connected to quantities encountered in Mueller's analysis of inclusive cross sections. Prescriptions for cuts in multiparticle processes emerge. A positive sign seems to be incompatible with the sum rules combined with simple crossing requirements. (auth)

27858 INVARIANT TRILINEAR COUPLINGS INVOLVING BOTH SU(2) AND SU(1,1) STATES. Patera, J.; Winternitz, P. (Univ. of Montreal). J. Math. Phys. (N.Y.); 14: No. 12, 1977-1983 (Dec 1973).

Multiplets $|JM\rangle$ transforming under irreducible representations of the algebra of SU(2) are constructed as infinite sums of products of two SU(1, 1) states $|^{\frac{1}{2}}_{-\gamma}\rangle$ and $|^{\frac{1}{2}}_{M+\gamma}\rangle$. The "generalized coupling coefficients" figuring in the construction are shown to exist if the SU(2) label J and the SU(1, 1) labels j and l satisfy $j = l + J - k$, $0 \le k \le 2J$. They are constructed explicitly and turn out to be analytic continuations of both SU(2) and SU(1, 1) Clebsch–Gordan coefficients. The constructed states $|JM\rangle$ are not normalizable in the usual sense. The "generalized coupling coefficients" can be applied, e.g., to study vertices, involving ordinary particles (with mass satisfying $m^2 > 0$ and SU(2) spin) and tachyons ($m^2 < 0$, SU(1, 1) spin). (auth)

27859 UNFOUND PARTICLES. Bilaniuk, O. M.; Boccio, J. R. (Swarthmore Coll., PA). Recherche (Paris); 4: No. 40, 1037-1047(Dec 1973). (In French).

Past success in chemistry and physics in seeking missing particles (Mendeleeff's classification in chemistry; the classification of elementary particles together with the neutron, and antiparticles together with the neutrino in physics) is recalled. The table presented establishes the importance and theoretical audaciousness of various currently conducted research projects concerning magnetic monopoles, gravitons, tachyons, quarks, gluons, as well as all other theoretically predicted entities still beyond the reach of the experimentalist. (auth)

27860 MUTUAL COHERENCE FUNCTIONS OF ELEMENTARY PARTICLES AND MULTIPLE PRODUCTION. Kopylov, G. I.; Podgoretskii, M. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 2, 434-446(Feb 1974). (In Russian).

Apparatus of mutual coherence functions is applied to calculate the correlations between identical particles produced in multiple generation processes. This enables one to prove a number of theorems independent of the concrete model of the multiple generation. In particular, it is shown that the Fourier analysis of the correlations between mesons enables one to find the distribution of distances between the meson sources inside the domain of their production. (auth)

27861 RESONANCES IN THE MULTIPERIPHERAL MODEL AND EXOTIC QUANTUM NUMBERS. Gendenshtein, L. E. (Physical-Technical Inst., Kazan). Yadern. Fiz.; 19: No. 2, 396-400(Feb 1974). (In Russian).

The relation is considered between the energy behavior of the cross section and the s-channel quantum numbers. A simple model is used to demonstrate this relation under the assumption of absence of the low-energy exotic resonances in the vertices of the multiperipheral chain. The cross section of the exotic channel appears to be smaller than that of the nonexotic one. The difference between the cross sections decreases as a power of energy and is connected with the contribution from supplementary multiperipheral diagrams arising in the case of nonexotic initial quantum numbers. Some other consequences following from the absence of the resonances with exotic quantum numbers in the multiperipheral model are considered. (auth)

27862 VIOLATION OF SCALING IN PRODUCTION OF PARTICLES WITH HIGH-TRANSVERSE MOMENTUM. Levin, E. M.; Ryskin, M. G. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 19: No. 2, 389-395(Feb 1974). (In Russian).

It is shown that in the multiperipheral model the production of a meson with a high transverse momentum results in a small $(\sim (\mu^2\sqrt{s}/q_t)^2)$ phase space of all other particles. Therefore the inclusive cross section $\omega d\sigma/d^3q = f(s,q_t)$ increases rapidly with energy (till it becomes $\sqrt{s} \gg q_t$). The main sources responsible for the variation of the phase space and for the energy dependence of $f(s,q_t)$ are discussed. The numerical results are compared with the experiment. (auth)

27863 REGGEON GRAPH TECHNIQUE FOR TOPOLOGICAL CROSS SECTIONS. Mandzhavidze, I. D. (Inst. of Physics, Tbilisi, USSR). Yadern. Fiz.; 19: No. 2, 370-379(Feb 1974). (In Russian).

Rules are formulated for the reggeon graph technique that enables one to calculate the topological cross sections independently on the concrete structure of the hadron multiple production amplitudes. An equation (similar to the Dyson equation) is obtained for the topological cross sections, as well as sum rules, playing the role of boundary conditions for solutions of this equation. (auth)

27864 CAUSALITY AND NULL-PLANE COMMUTATORS. Ahmed, M. A. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim.; 20A: No. 1, 72-84(1 Mar 1974).

The null-plane commutator of two conserved isovector currents between single-particle states in the forward direction is derived using the causal Dyson representation. In particular, the q-number Schwinger terms are studied. The further restrictions due to scaling behavior are also discussed. (auth)

27865 UNITARY FOLDY–WOUTHUYSEN OPERATOR FOR PARTICLES OF ARBITRARY SPIN. Alagar Ramanujam, G. (Nallamuthu Gounder Mahalingam Coll., Pollachi, India). Nuovo Cim., 20A: No. 1, 27-34(1 Mar 1974).

A generalized Foldy-Wouthuysen operator which remains unitary and at the same time related to the Lorentz transformation was obtained for particles of arbitrary spin. The operator has a simple exponential form and is obtained as a product of two operators S and L. While the operator L is obtained from the Lorentz transformation, the operator S is constructed such

that SL becomes unitary. The Hamiltonian, obtained by making a similarity transformation of the rest frame Hamiltonian with this generalized operator, is found to be exactly the same as that obtained by Weaver, Hammer and Good and by Mathews independently. A similar generalized unitary operator to get at the extreme relativistic representation is also given. (auth)

Electromagnetic

Refer also to abstracts 28181 and 28567.

27866 (AD-766923-7) QUANTUM PROPERTIES OF FLUIDS AND SOLIDS, PHYSICS, AND INTERACTING PARTICLES AND FIELDS. Final Report. Walecka, J. D.; Fetter, A. L. (Stanford Univ., Calif. (USA). Dept. of Physics). Aug 1973. Contract F44620-71-C-0044. 31p. (AFOSR-TR-73-1629). NTIS $3.75.

A summary of the research progress and activities for the period from 1 June 1971 to 30 June 1973 is given. Research was carried out in the following areas: intermediate energy physics—semi-leptonic weak and electromagnetic interactions with nuclei, the optical model, multiple scattering expansions; nuclear photoproduction of charged pions; K-mesic atoms and pion-muon atoms; low-temperature physics—liquid helium; absorbed helium; charged Bose gas many-electron systems; superconductivity; many-body theory—interacting Fermi systems; Green's function treatment of many body systems at high temperature; high energy physics—field theory; weak interactions; hadronic and electromagnetic interactions at high energy; electroproduction. Approximately 50 papers were published on this research. (auth)

27867 (DESY-73-48) $\gamma\gamma \rightarrow$ HADRONS: ASYMPTOTIC BEHAVIOR AND DEEP INELASTIC SCATTERING. Walsh, T. F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Oct 1973. 32p. (CONF-730988-1). Dep. NTIS $3.75.

From international colloquium on photon-photon collisions in electron-positron storage rings; Paris, France (3 Sep 1973).

The asymptotic behavior of one or more of the three variables of the process q_1^2, q_2^2, and s for the process $\gamma + \gamma \rightarrow$ hadrons is treated based on the parton model in the general sense of a field theory with soft off-shell behavior or a transverse momentum cutoff. This is in most cases a physical realization of the algebra of currents on the light cone and is of reasonable generality. (JFP)

27868 (INIS-mf-1015) ELECTROMAGNETIC DECAY AMPLITUDES IN THE SYMMETRIC QUARK MODEL. Shellard, R. C. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1973. 45p. (In Portuguese). INIS.

Thesis.

In order to calculate the electromagnetic decay amplitudes, the symmetric quark model with harmonic oscillator forces is used. The calculation is a nonrelativistic one, and the need of performing the calculation in the semi-Breit system (Breit system for the velocities), in order to attenuate the relativistic effects is stressed. The electroproduction cross section of the Δ^+ (1236) resonance is briefly discussed. (auth)

27869 (SLAC-167(Vol. 1), pp 1-34) HADRON PRODUCTION IN DEEP INELASTIC PROCESSES. Bjorken, J. D. (Stanford Linear Accelerator Center, CA). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume I.

A lecture is given on the expectations for hadron final states for the deep inelastic processes $e^- + p \rightarrow e^- +$ hadrons, $\nu_\mu + p \rightarrow \mu^- +$ hadrons, and $e^+ + e^- \rightarrow$ hadrons which are treated in a general way with as little recourse to models as possible. The purpose is to try to develop a qualitative and semiquantitative idea of what might be reasonable experimental results. The strategy is to assume that the phenomena in the high Q^2 unknown regions are smoothly connected to the known regions and that there is no discontinuity in the dynamics. It is concluded that all quantities show no systematic variation with Q^2 at fixed W provided they are normalized to the total cross section at that Q^2 and W. (JFP)

27870 (SLAC-167(Vol. 1), pp 82-92) PHENOMENOLOGICAL ANALYSIS. Part II. Fixed Poles in Photoproduction and Electroproduction. Gilman, F. J. (Stanford Linear Accelerator Center, CA). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume I.

Fixed poles particularly in regard to their presence in two-current amplitudes are reviewed. Compton scattering of real photons and electroproduction are considered. (JFP)

27871 (SLAC-167(Vol. 1), pp 119-135) INCLUSIVE ELECTROPRODUCTION OF HADRONS FROM PROTONS AND NEUTRONS AND TESTS OF THE QUARK-PARTON MODEL. Feldman, G. J. (Stanford Linear Accelerator Center, CA). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume I.

Data are presented on the inclusive electroproduction of hadrons from proton and neutron targets. The most striking behavior is the excess of positive to negative hadrons in the photon fragmentation region from both proton and neutron targets. It is shown that these charge ratios can be understood quantitatively in a reasonable quark-parton model. Predictions of this model for charge ratios in electroproduction, neutrino production, and e^+e^- annihilation are investigated. (auth)

27872 (SLAC-167(Vol. 1), pp 289-311) ANALYTIC CONTINUATION FROM THE SCATTERING TO THE ANNIHILATION REGION. Sullivan, J. D. (Univ. of Illinois, Urbana). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume I.

In this review a discussion is given of what relation if any exists between the structure functions $F_{1,2}(\omega)$ of deep inelastic scattering and the corresponding structure functions $\bar{F}_{1,2}(\omega)$ of the deep inelastic annihilation region. The question is considered in two parts: Does scaling behavior for the scattering $e^- + p \rightarrow e^- + X$ imply scaling behavior for the annihilation $e^+ + e^- \rightarrow \bar{p} + X$? and if so can $\bar{F}_{1,2}(\omega)$ be obtained from $F_{1,2}(\omega)$ by analytic continuation? These questions are answered in the affirmative after pointing out certain subtleties in carrying out the analytic continuation. (JFP)

27873 (SLAC-167(Vol.2), pp 77-117) GAUGE-THEORIES OF WEAK AND ELECTROMAGNETIC INTERACTION. Appelquist, T. (Harvard Univ., Cambridge, MA); Primack, J. Nov 1973.

In Proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume II.

Lectures are given as an introduction to gauge theories and to survey recent work. The topics are problems with the Fermi and IVB theories, current conservation and gauge invariance, renormalization of the unbroken Yang-Mills theory, spontaneous symmetry breaking, the Higgs mechanism and the Weinberg model, the renormalization program, neutral currents of heavy leptons, production and decay of heavy lepton, and higher order neutral currents. Also covered are $\Delta s = 1$ neutral currents, charm and its consequences, alternatives to charm, finite symmetry breaking, μ-e universality, mass shifts, and short distance behavior. (JFP)

27874 INFORMATION CONTENT OF BEAM POLARIZATION IN $e^+e^- \rightarrow$ MULTIHADRONS. Avram, N. M. (Univ. of Timisoara, Rumania); Schiller, D. H. Nucl. Phys.; B70: No. 2, 272-296(1974).

The density matrix elements of the final multihadron states produced in e^+e^- annihilation are studied and the additional information obtainable, in the one-photon exchange approximation, from beam polarization is discussed. It turns out that most of the new information is due to the longitudinal polarization of at least one beam. Nothing can be learned from the transverse polarization of only one beam, and very little from that of both beams. (auth)

27875 ANOMALOUS MAGNETIC MOMENT OF THE MUON AND SHORT-DISTANCE BEHAVIOR OF QUANTUM ELECTRODYNAMICS. Lautrup, B.; de Rafael, E. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). Nucl. Phys.; B70: No. 2, 317-350(1974).

The leading contributions to the anomalous magnetic moment of the muon due to electron vacuum polarization corrections are governed by the short-distance behavior of the photon propagator. It is found that the formulation of this relationship in terms of a Callan-Symanzik equation for the muon anomaly is extremely useful for an actual evaluation of the leading mass dependent terms (i.e., terms proportional to powers of $\log m_\mu/m_e$). This enables us to predict all the mass dependent terms from a large class of eighth-order Feynman diagrams, in addition to verifying previously calculated lower order contributions, without much calculational effort. It is emphasized that "light-by-light" type contributions are not included in this calculation. The mass independent terms contributing to the muon anomaly were also evaluated from a more restricted class of Feynman diagrams. (auth)

27876 CORRECTION TO THE SIXTH-ORDER ANOMALOUS MAGNETIC MOMENT OF THE MUON. Samuel, M. A. (Oklahoma State Univ., Stillwater). Nucl. Phys.; B70: No. 2, 351-355 (1974).

The contribution to the anomalous magnetic moment of the muon from the sixth-order double-bubble diagram is evaluated to $O(m_e/$

m_μ). The value obtained is: $(\alpha/\pi)^3$ [(2/9) ln $^2(m_\mu/m_e)$ – (25/27)ln (m_μ/m_e) + (317/324) + $(\pi^2/27)$ – $(4\pi^2/45)$ (m_e/m_μ)] = 2.7199 $(\alpha/\pi)^3$. (auth)

27877 HADRON PRODUCTION IN VIRTUAL PHOTON–PHOTON ANNIHILATION. Koepp, G. (Technische Hochschule, Aachen); Walsh, T. F.; Zerwas, P. Nucl. Phys.; B70: No. 3, 461-485(1974).

A systematic study is made of the amplitudes for annihilation of two virtual photons into hadron resonances and continuum states, a process measurable with colliding electron-positron beams. The asymptotic behavior of resonance form factors and their absolute scale follows from light cone or parton model considerations; definite predictions for inclusive two-photon annihilation are derived by the same methods. (auth)

27878 DIRAC EQUATION. Temchin, A. N. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 96-100(1973). (In Russian).

A connection is established between the solutions of the Dirac equation (for electrons in a constant magnetic field) and wave equations for particles with zero mass. (tr-auth)

27879 SYNCHROTRON RADIATION OF ELECTRONS MOVING ON AN ELLIPTICAL ORBIT IN THE PRESENCE OF AXIAL OSCILLATIONS. Kul'kin, A. G.; Mussa, A. Kh.; Pavlenko, Yu. G.; Petukhov, V. I. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 96-100(1973). (In Russian).

It was shown that because of radial oscillations and the difference of the forms of equilibrium orbits from circular orbits there is a substantial change of the spectral-angular and polarization characteristics of the synchrotron radiation in comparison with the case of motion around a circle of constant radius. (3 graphs) (tr-auth)

27880 LECTURES ON THE THERMODYNAMIC LIMIT FOR COULOMB SYSTEMS. Lieb, E. H. (Massachusetts Inst. of Tech., Cambridge); Lebowitz, J. L. Lect. Theor. Phys.; 14B: 423-460(1973).

An outline is presented of the proof of the existence of the thermodynamic limit for Coulomb systems. Sometimes only the simplest kind of Coulomb system: two species of charged particles (one positive and one negative) whose only interaction is through the Coulomb potential. Other times various lemmas and theorems are stated without proof. (JFP)

27881 PION AND KAON ELECTROMAGNETIC MASSES IN CHIRAL PERTURBATION THEORY. Langacker, P.; Pagels, H. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 8: No. 12, 4620-4627 (15 Dec 1973).

We examine the electromagnetic self-energies of the ground-state mesons in chiral perturbation theory about SU(2) × SU(2) and SU(3) × SU(3), to leading order in the electromagnetic interaction. If ϵ is a measure of chiral breaking, then the leading-order corrections to the ground-state meson level splitting relative to the symmetry limit is ϵ lnϵ. For the pion electromagnetic-mass difference expanded around the chiral SU(2) × SU(2) limit, all terms of $O(\mu_\pi^2 \ln\mu_\pi^2)$ are calculated and are found to give only a 12% correction. For chiral SU(3) × SU(3) one has Dashen's sum rule $\mu_{\pi^+}^2 - \mu_{\pi^0}^2 = \mu_{K^+}^2 - \mu_{K^0}^2$ in the symmetry limit. We explicitly calculate the leading correction to the symmetry limit and find that it is larger than the symmetric term, establishing the breakdown of chiral SU(3) × SU(3) perturbation theory in this application and the assumption on which the Dashen sum rule was based. We conjecture that these remarks are valid in the context of gauge models and suggest that the power-series expansions in α = fine-structure constant can fail in some gauge models, there being terms of the form α lnα. (auth)

27882 THEORETICAL ANALYSIS OF THE FRASCATI DATA ON THE SINGLE-BREMSSTRAHLUNG PROCESS $e^+e^- \rightarrow e^+e^-\gamma$. Calva-Tellez, E. (Departamento de Física, Centro de Investigación y de Estudios Avanzados del Instituto Politecnico Nacional, Apartado Postal 14-740, Mexico 14, D. F.). Phys. Rev. D 8: No. 11, 3856-3866 (1 Dec 1973).

The angular distributions of the process $e^+e^- \rightarrow e^+e^-$ measured by the Bologna-CERN-Frascati group at the electron-positron colliding-beam facility Adone are analyzed in terms of standard quantum electrodynamics (QED) to order α^3 including soft- and hard-photon emission. An analytical expression is given for the cross section of the process $e^+e^- \rightarrow e^+e^-\gamma$ for hard photons. Detailed numerical results for that specific experimental setup are obtained by a Monte Carlo program. It is found that this bremsstrahlung process is responsible for the noncollinear and noncoplanar events observed at Frascati. Therefore, these data, together with the present calculation, provide a test of QED for this particular physical situation involving high energies and large momentum transfers. (auth)

27883 RADIATIVE MESON DECAYS IN A QUARK-OSCILLATOR MODEL. Berger, S.B.; Feld, B.T. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 8: No. 11, 3875-3881 (1 Dec 1973).

One- and two-photon decays of meson resonances are calculated in a quark-oscillator model using a nonrelativistic interaction Hamiltonian and vector dominance. Harmonic-oscillator wave functions are assumed for I = 0 and I = 1 resonances (e.g., π, ρ and A_2, f, respectively). The calculations in general are sensitive to the value of the well-width parameter α^2. Good agreement with experiment is obtained for decays of low-lying states (such as π^0 and η) and for the decay $A_2^+ \rightarrow \pi^+ + \gamma$ [Γ (predicted) = 0.4-0.6 MeV]. The calculated width for the decay f(1260) $\rightarrow \gamma\gamma$ is less than that predicted by Kunzst et al, on the basis of a phenomenological Lagrangian by a factor of 3 or more. (auth)

27884 GREEN'S-FUNCTION APPROACH TO INVERSE COMPTON SCATTERING. Yeung, P.S. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey, 08540); Brown, R.L. Phys. Rev. D 8: No. 12, 4286-4297 (15 Dec 1973).

The emission, absorption, and transfer of radiation produced through the Compton interaction of relativistic electrons with microwave photons in a homogeneous source is considered. It is shown that the intensity of Compton-scattered radiation can be conveniently expressed in terms of a Green's function and this enables the radiation-transfer problem for arbitrarily many scatterings to be formalized in terms of a series of appropriately defined scattering vertex functions and absorption propagators. A rigorous discussion of the cross section for inverse Compton scattering is presented which is valid both in the extreme relativistic ($\gamma \gg 1$) and weakly relativistic limits ($\gamma \simeq 1$). Using these results the spectral behavior of the intensity of Compton-scattered radiation is evaluated explicitly for once- and twice-scattered photons; the qualitative features of the multiple-scattering problem are described. At sufficiently high frequencies the spectral behavior of the first- and all higher-order scatterings is the same. (auth)

27885 P-A_2 EXCHANGE DEGENERACY AND THE ADLER SUM RULE. Wada, W.W. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. D 8: No. 11, 4217-4221 (1 Dec 1973).

On the basis of ρ-A_2 exchange degeneracy, the structure functions for virtual Compton scattering with I = 1 and C = $\pm$ 1 in the t channel are assumed proportional to one another. The constant of proportionality is determined by the threshold relation of Bloom and Gilman. The Adler sum rule (I = 1, C = -1) is found to be consistent with the observed behavior of the structure function (I = 1, C = +1) in the scaling region. A simple proportionality relation between ν ($W^{ep}_2 - W^{ep}_1$) and ν ($W^{\gamma p}_2 - W^{\gamma n}_2$) is obtained in the scaling limit. (auth)

27886 KAON PARTIAL-CONSERVATION-OF-AXIAL-VECTOR-CURRENT ANOMALY AND $K_L \rightarrow \gamma\gamma$ DECAY. McKay, D.W. (University of Kansas, Lawrence, Kansas 66044). Phys. Rev. D 8: No. 11, 4182-4192 (1 Dec 1973).

The low-energy theorem is derived which relates the invariant vertex function of $K_L \rightarrow \gamma\gamma$ to the corresponding function of $\langle 2\gamma|[Q^5_3, L_-]|0\rangle$, where it is assumed that Schwinger and seagull terms, if present, cancel against each other. A chiral Lagrangian model is studied which satisfies PCAC and which has an octet weak Lagrangian with $[Q^5_3, L_-] = 0$. In this model, the effective $K_L \rightarrow \gamma\gamma$ coupling constant produced by certain baryon loop graphs is found to remain finite as the momentum of the kaon goes to zero. This contradicts the low-energy theorem and indicates the failure of seagull and Schwinger terms to cancel. The effective coupling produced by this anomaly is estimated to give a rate roughly comparable to the experimental one. Implications for mesonic effective-Lagrangian studies of K decays are discussed. (auth)

27887 LIMITS ON THE ISOTENSOR ELECTROMAGNETIC CURRENT IN PION PHOTOPRODUCTION. Donnachie, A.; Shaw, G. (Department of Physics, University of Manchester, Manchester, England). Phys. Rev. D 8: No. 11, 4198-4202 (1 Dec 1973).

Recent data on the π^-/π^+ ratio for photoproduction in the first resonance region are analyzed using a model developed previously. Within the model, the data set an upper limit of about 3 percent on the ratio of isotensor to isovector resonance excitation, assuming T invariance. The π^- radiative-capture data are investigated again within the model, to assess the evidence for this latter assumption. (auth)

27888 CORRECTIONS TO EQUIVALENT-PHOTON APPROXIMATION FOR TWO-PHOTON PROCESSES IN COLLIDING BEAMS. Subbarao, K. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 8: No. 11, 4041-4050 (1 Dec 1973).

The cross section for the two-photon process $ee \rightarrow ee\,\Gamma$ in colliding electron beams, in the limit $E \rightarrow \infty$ with E^2/s fixed (E being the energy per beam of the colliding electrons of mass m, and $\sqrt{s}$ the invariant mass of the state Γ), is well known to have a leading term of order $[\ln(4E^2/m^2)]^2$. This leading term is given correctly by the

well-known Weizsäcker-Williams approximation or the equivalent-photon approximation. There are sizable corrections coming from nonleading terms, of which the first, namely the term of order $\ln(4E^2/m^2)$, has been obtained for an arbitrary hadronic final state Γ. The approximations made in getting the Weizsäcker-Williams result and the correction terms due to each of them have been exhibited. (auth)

27889 DECAY SPECTRA OF PARTICLES AND RESONANCES PRODUCED IN A CENTRAL PLATEAU. Barnett, R.M.; Silverman, D. (University of California, Irvine, Irvine, California 92664). Phys. Rev. D 8: No. 11, 4151-4156 (1 Dec 1973).

We consider the two-body decay of the spinless resonance or particle produced in a central plateau, with an arbitrary transverse-momentum spectrum. The spectrum of the decay products is calculated exactly as an integral over the spectrum of the centrally produced resonance or particle. Special forms applicable to large and small momentum transfer are presented along with an accurate inversion formula. We show how the large-transverse-momentum behavior of the resonance production is replicated in the decay products. The decay $\pi^0 \to \gamma + \gamma$ is considered in detail. (auth)

27890 e^+e^- ANNIHILATION IN GAUGE THEORIES OF STRONG INTERACTIONS. Appelquist, T.; Georgi, H. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 8: No. 11, 4000-4002 (1 Dec 1973).

We discuss the behavior of the e^+e^- total annihilation cross section into hadrons in a class of non-Abelian vector gluon theories. Using the quasi-free-field behavior of these theories in the deep Euclidean region, we show that the asymptotic behavior of $\sigma^{e^+e^-}_{tot}$ is that of the parton model. Nonleading corrections fall off relative to this leading term like inverse powers of logarithms with calculable coefficients. The problem of making more detailed statements about the final state is discussed. (auth)

27891 ELECTRON-POSITRON ANNIHILATION IN STAGNANT FIELD THEORIES. Zee, A. (The Rockefeller University, New York, New York 10021). Phys. Rev. D 8: No. 11, 4038-4041 (1 Dec 1973).

We discuss the ratio $R(s) \equiv \sigma(e^+e^- \to \text{hadrons})/\sigma(e^+e^- \to \mu^+\mu^-)$ in stagnant (asymptotically free) field theories. The leading correction to the scaling limit is determined. (auth)

27892 PRODUCTION AND DECAY OF HEAVY VECTOR MESONS IN A STATISTICAL MODEL. Margolis, B.; Meggs, W.J.; Rudaz, S. (Physics Department, McGill University, Montreal 101, Quebec, Canada). Phys. Rev. D 8: No. 11, 3944-3951 (1 Dec 1973).

The assumption is made that there are many heavy vector mesons with density given by the statistical bootstrap. Using statistical methods and generalized vector dominance we are then able to calculate angle-integrated cross sections for the reactions $e^+e^- \to \pi^+\pi^-$, $\gamma p \to (p\pi\pi)p$, and γnucleus $\to \pi^+\pi^-$nucleus. We also calculate $\pi p \to (p\pi\pi)\Delta$ which does not involve vector dominance. The results compare well with experiment, and along with results previously obtained for other reactions, demonstrate a method for calculating spectral shapes for many processes. (auth)

27893 SPECTRAL REPRESENTATION AND OPERATOR-PRODUCT EXPANSIONS. Ahmed, M.A.; Khan, I. (Physics Department, University of Khartoum, Khartoum, Sudan). Phys. Rev. D 8: No. 12, 4644-4647 (15 Dec 1973).

We discuss the question of generating the singularity structure of the vacuum expectation value of the commutator of two electromagnetic currents as given by operator-product expansions, from the Källén-Lehmann representation. It is shown that this is possible provided the formally divergent integrals involving the spectral function are interpreted suitably. An example is discussed in detail. (auth)

27894 ANALYSIS OF ELECTROMAGNETIC MASS SHIFT IN LIGHT-CONE ALGEBRA. Fayyazuddin; Riazuddin (Institute of Physics, University of Islamabad, Islamabad, Pakistan). Phys. Rev. D 8: No. 12, 4635-4638 (15 Dec 1973).

Within the framework of light-cone algebra, it is shown that a logarithmic divergence in the electromagnetic mass shift of a hadron arises precisely due to a mass term in the quark propagator. This divergence, therefore, can be removed by mass renormalization. The coefficient of this divergence is a scalar density which transform as S_3 for the case of a nucleon. In our analysis, the gauge invariance to order $1/q^2$ is explicitly used. (auth)

27895 INDUCED PSEUDOSCALAR COUPLING CONSTANT AND LIGHT-CONE SUM RULES. Dicus, D.A. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627); Teplitz, V.L. Phys. Rev. D 8: No. 12, 4532-4544 (15 Dec 1973).

We derive formulas giving the bilocal form factors, which appear in the matrix element of light-cone commutators, as Fourier transforms of scaling limits of electron scattering structure functions. We deal with the case of nonforward, spin-dependent, virtual Compton scattering. By taking the local limit of an appropriate bilocal form factor we find a new rule for the induced pseudoscalar coupling constant of nuclear beta decay. (auth)

27896 APPROXIMATE SOLUTIONS OF PREDICTIVE RELATIVISTIC MECHANICS FOR THE ELECTROMAGNETIC INTERACTION. II. Bel, L.; Martin, J. (Universidad Autónoma de Madrid, Departamento de Física, Canto Blanco-Madrid, Spain). Phys. Rev. D 8: No. 12, 4347-4353 (15 Dec 1973).

We solve the equations of predictive relativistic mechanics for the electromagnetic interaction of two structureless point charges, up to the first order in the mass ratio $\lambda \equiv m_1/m_2$, using as subsidiary conditions the Liénard-Wiechert formulas for both the advanced and retarded potentials. The perturbation technique used in this paper is, of course, only useful when λ is a small number, but in this case it is more powerful than the technique used in a preceding paper by Bel, Salas, and Sánchez where the parameter used in the developments was the coupling constant. (auth)

27897 SPECTRAL REPRESENTATION FOR ELASTIC PHOTON-PHOTON SCATTERING. Ivanetich, R.J. (Department of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 8: No. 12, 4564-4573 (15 Dec 1973).

The derivation of spectral forms in source theory has recently been systematically developed for systems of scalar particles. Elastic photon-photon scattering in lowest nonvanishing order is here studied as a simple, but representative, example of the additional considerations necessitated by particles having internal quantum numbers. The amplitude is determined as a double-spectral form augmented by a single-spectral one, the latter being related to the imposition of gauge invariance. Also presented is some discussion on how, in source theory, one obtains at given order all the contributions to the amplitude. (auth)

27898 EFFECT OF THE MEDIUM ON BREMSSTRAHLUNG RADIATION FROM AN ELECTRON IN THE ATOMIC FREQUENCY RANGE. Bazylev, V. A.; Varfolomeev, A. A.; Zhevago, N. K. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 2, 464-475(Feb 1974). (In Russian).

The effect of virtual quantum absorption due to the photoeffect and scattering by quasidiscrete levels of the medium atoms on the bremsstrahlung spectrum of ultrarelativistic electrons in the medium is considered. The classical method is applied. Analytical expressions for the bremsstrahlung spectrum in a dense medium are obtained in a broad range of atomic frequencies by taking into account virtual quantum absorption. It is shown that in the vicinity of the absorption lines and the edge of photoabsorption of the medium the processes under consideration lead to a pronounced change in the bremsstrahlung spectrum. (auth)

27899 X-RAY TRANSITION RADIATION PRODUCED IN AN IRREGULAR MEDIUM. Garibyan, G. M.; Gevorgyan, L. A.; Yan Shi. (Erevan Physics Inst.). Zh. Eksp. Teor. Fiz.; 66: No. 2, 552-565(Feb 1974). (In Russian).

A formula is derived for the spectral distribution of the x-ray transition radiation quanta produced in an irregular medium consisting of randomly distributed plates of arbitrary thickness which are parallel to each other. Absorption of the radiation in the plates is taken into account in the formulas. The formula is averaged over the thicknesses and distances between the plates for arbitrary distributions of these quantities. In the limiting case of zero irregularity, the familiar formula for x-ray transition radiation in a regular stack can be derived from the general formula. In another limiting case, when the medium is extremely irregular (i.e., when the spread of the plate thicknesses and of the distances between them are much greater than formation zones in matter and vacuum respectively), the number of radiation quanta produced in the medium is an additive sum of the number of radiation quanta produced at the boundaries. A numerical calculation is performed for a model in which the plate thicknesses and distances can be described by a gamma-distribution. (auth)

27900 MULTI-BODY PRODUCTION OF MESONS. Meyer, H. (Univ. of California, Santa Cruz). (1973). 26p.

From international symposium on electron and photon interactions at high energies; Bonn, Germany (27 Aug 1973).

A discussion is given on multimeson photo and electroproduction, particularly discussing the problem of how individual final states build up the total cross section. Individual final states will be defined in terms of charged particle multiplicities, channel cross sections and contributions due to resonance channels. Photoproduction data on proton and neutron targets, with particular emphasis on possible differences between them is considered. The few results on electroproduction which are available at this time will be examined as a function of Q^2 and W, and again for electroproduction one looks at particle production in terms of

t and M(x), the t-channel variable s, and finally, on possible contributions from individual final states to the π^+/π^- ratio. (GE)

27901 TWO-PARTICLE GREEN FUNCTIONS IN THE ELECTRON GAS THEORY. Ozrin, V. D.; Oleinikov, V. P. (Moscow State Univ.). Teor. Mat. Fiz.; 18: No. 2, 252-261(Feb 1974). (In Russian).

Approximate solution of the chain of equations for irreducible parts of the commutator two-time temperature Green functions is considered, which successively takes into account the dynamical screening of the Coulomb interaction in the first order exchange terms. The expression for the polarization operator of the system is obtained and the dispersion of the plasma frequency at low temperature is calculated. (auth)

27902 VARIOUS FORMS OF THE ELECTRON PROPAGATOR IN THE COULOMB FIELD. Granovskii, Ya. I.; Nechet, V. I. (Donetsk State Univ., USSR). Teor. Mat. Fiz.; 18: No. 2, 262-266(Feb 1974). (In Russian).

Some new expressions for the propagator of the electron moving in the Coulomb field, which greatly simplify practical calculations, are obtained and discussed. (auth)

27903 T MATRIX FOR ELECTROMAGNETIC SCATTERING FROM AN ARBITRARY NUMBER OF SCATTERERS AND REPRESENTATIONS OF E(3). Peterson, B.; Stroem, S. (Inst. of Theoretical Physics, Goteborg). Phys. Rev., D; 8: No. 10, 3661-3678(15 Nov 1973).

The T-matrix formulation of electromagnetic scattering given previously by Waterman for the case of one scatterer is extended to the case of an arbitrary number of scatterers. The resulting total T matrix is expressed in terms of the individual T matrices by an iterative procedure. The essential tools used in the extension are the expansions associated with a translation of the origin for the spherical-wave solutions of Helmholtz's equation. The connection between these expansions and the unitary irreducible representations and associated local representations of the three-dimensional Euclidean group E(3) is emphasized. Some applications to two spheres are given. (auth)

27904 NON-LEADING TERMS IN THE LIGHT-CONE EXPANSION AND ELECTROMAGNETIC MASS DIFFERENCES. Holwerda, M. J. (Univ., Nijmegen, Netherlands). Nucl. Phys.; B70: No. 1, 83-92(1974).

It is shown to what extent nonleading terms in the FGM light-cone expansion (of conserved currents) are determined by the requirement of gauge invariance. A consistent short distance limit of the light-cone expansion is only obtained by taking these secondary terms into account. In this way the expression for the logarithmically divergent term in electromagnetic mass differences is rederived. (auth)

27905 STRING MODEL AND MULTIPRODUCTION. Artru, X.; Mennessier, G. (Paris Univ., Orsay, France). Nucl. Phys.; B70: No. 1, 93-115(1974).

The string model for the hadrons offers a classical description of high energy collisions which accounts for the following features: leading particle effect, limiting fragmentation, rapidity plateau, logarithmic growth of multiplicity, small transverse momenta. A simplified two-dimensional model allows one to study quantitatively these properties as well as the effect of SU(3) mass breaking. The relevance of this model to current-induced reactions is discussed, and some predictions are made concerning e^+e^- → hadrons. (auth)

27906 COVARIANT ANGULAR MOMENTUM RADIATION RATE FOR A CHARGED POINT DIPOLE. Emid, S. (Technische Hogeschool, Delft, Netherlands); Vlieger, J. Physica; 70: No. 3, 627-629(15 Dec 1973).

It is shown that the covariant expression for the angular momentum radiation rate for a uniformly moving charged point dipole derived is identical with the covariant expression recently found by Van Weert for this case. His statement, that the former expression is not correct, is therefore not justified. (auth)

27907 MOTION IN RADIAL MAGNETIC FIELDS. Hautot, A. (Univ., Liege). J. Math. Phys. (N.Y.); 14: No. 12, 2011-2017 (Dec 1973).

The problem of the motion of a charged particle in radial magnetic induction fields of the type $B = h(\theta)r/r^3$ is studied. A Coulomb electric field is also added. The mechanics of Newton, Einstein, Schrödinger, and Dirac are successively considered in view of exact solutions. The analogies between the four treatments are emphasized. (auth)

27908 GAUGE INVARIANT CANONICAL MECHANICS FOR CHARGED PARTICLES. Torrence, R. J.; Tulczyjew, W. M. (Univ. of Calgary, Alberta). J. Math. Phys. (N.Y.); 14: No. 12, 1725-1732(Dec 1973).

The mechanics of charged particle motion is presented in a five-dimensional form compatible with the five-dimensional Kaluza theory of the electromagnetic field. Gauge dependence is given an intrinsic geometrical interpretation and the role of generalized momenta is clarified. The theory is a new example of a mechanical system with constraints and offers an interesting exercise in canonical quantization with a nonstandard Poisson bracket. (auth)

27909 DUAL LIGHT-CONE MODEL FOR THE STRUCTURE FUNCTIONS OF DEEP INELASTIC SCATTERING AND ANNIHILATION. Schierholz, G.; Schmidt, M. G. (Stanford Univ., CA). Phys. Lett.; 48B: No. 4, 341-344(18 Feb 1974).

Abstracted from a dual model, a concrete ansatz is presented for the light-cone spectral function $F(\alpha,\beta,t)$ recently discussed by Gatto and Preparata and the correct continuation prescription from deep inelastic scattering to the annihilation region is given. The scaling properties of this ansatz are discussed and, in particular, it is shown that the deep inelastic structure functions fulfill a new type of Gribov–Lipatov reciprocity relation. (auth)

27910 $SU_2 \times SU_2$ BREAKING, CABIBBO ANGLE, AND $\eta \to 3\pi$ DECAY IN A NONLINEAR LAGRANGIAN MODEL. Ebrahim, A.; Serdaroglu, M. (Middle East Technical Univ., Ankara). Phys. Lett.; 48B: No. 4, 338-340(18 Feb 1974).

$SU_2 \times SU_2$ breaking, Cabibbo angle, nonelectromagnetic isospin breaking, and $\eta \to 3\pi$ decay are related in a nonlinear Lagrangian model of broken chiral $SU_3 \times SU_3$ symmetry. Excellent agreement with experiment is obtained for both the value of the Cabibbo angle and $\eta \to 3\pi$ decay rate. (auth)

27911 OPTIMAL REACTIONS FOR THE SEARCH FOR $\pi^0 \to e^+e^-$. Burkhardt, H.; Zia, R. K. P.; Davies, J. D. (Univ. of Birmingham, Eng.). J. Phys., A (London); 7: No. 1, 40-49(1 Jan 1974).

Various reactions are examined in which one might search for $\pi^0 \to e^+e^-$; apart from the problem of the low branching ratio, the most serious observational difficulties arise from the competition of intermediate virtual photon states of close to the pion mass. It is shown that the obvious choice of $\pi^-p \to \pi^0n$ at threshold is an unfavorable pion source but that the same reaction in the $\Delta(1236)$ resonance region seems currently to offer the best opportunity; it is analyzed in detail. $K^+ \to \pi^+\pi^0$ seems the most hopeful alternative. (auth)

27912 DOUBLE BREMSSTRAHLUNG IN THE SAME DIRECTION IN e^+e^- COLLIDING BEAMS. Kuraev, E. A.; Lipatov, L. N.; Merenkov, N. P.; Fadin, V. S.; Khoze, V. A. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 19: No. 2, 331-339(Feb 1974). (In Russian).

Weizsäcker–Williams approximation is used to calculate the hard part of the two-photon spectrum produced in the direction of one of the incident particles in e^+e^- colliding beams. For the case of the soft photon emission the method of classical currents is used. The distribution of the total energy of final photons is also found. (auth)

27913 COMPARISON BETWEEN BREMSSTRAHLUNG CROSS SECTION MEASUREMENTS AT THE SHORT WAVELENGTH LIMIT AND THEORETICAL RESULTS. Dautrey, H.; Dugne, J. J.; Proriol, J. (Univ., Clermont, France). Phys. Lett.; 47A: No. 2, 107-108(11 Mar 1974).

Recent precise measurements of the electron bremsstrahlung cross section $d^2\sigma/dk\, d\Omega_k$ at the short wavelength limit for an incident electron energy of 1.84 MeV show important discrepancies between experimental results and earlier theoretical calculations. A new exact theoretical result, for a point Coulomb potential is presented; discrepancies with experimental results remain. (auth)

27914 PHOTO- AND ELECTRODISINTEGRATION OF INDEPENDENT-PARTICLE MODEL NUCLEI. Erdas, F. (Univ., Cagliari, Italy); Pompei, A.; Quarati, P. Nuovo Cim.; 20A: No. 1, 169-178(1 Mar 1974).

The formulas deduced in previous work on the photo- and electrodisintegration of the deuteron are extended in order to understand the relation between the cross sections for the two-body photo- and electrodisintegration of independent-particle model nuclei and, by means of a modification of the interaction operator, these relations for nuclear disintegration in the many-body system. (auth)

27915 ELECTRON–POSITRON ANNIHILATION INTO HADRONS AT ULTRA HIGH ENERGIES. Choudhury, D. K.; Schilcher, K. (Oxford Univ.). Nuovo Cim.; 20A: No. 1, 134-140(1 Mar 1974).

It is demonstrated that the ratio $R = \lim_{s\to\infty} [\sigma(e^+e^- \to \text{hadrons})/\sigma(e^+e^- \to \mu^+\mu^-)]$ will rise as $(\log s)^2$ at asymptotic high energy where two-jet structure of final-state hadrons will be dominant. The conclusion is based on the hypothesis that the spectral function of the photon propagator approaches a constant limit as $s \to \infty$, which is true in a free-field theory. A numerical estimate of this process is made in the intermediate-energy region using vector-meson dominance and compared with the usual two-photon process $e^+e^- \to e^+e^-h$ (h = hadron). (auth)

27916 ALTERNATIVE METHOD FOR ESTIMATING THE DEUTERON CORRECTIONS IN DEEP INELASTIC SCATTERING. Berkmen, H.; Hacinliyan, A. (Middle East Technical Univ., Ankara). Nuovo Cim.; 20A: No. 1, 141-155(1 Mar 1974).

A method based on the analytical properties of the virtual photon-deuteron amplitude is suggested for extracting the neutron data from deep inelastic electron-deuteron data. An integral representation for this amplitude is obtained. Preliminary calculations using this representation are in agreement with the West calculation. (auth)

Weak

27917 (CRN/HE-73-14) RECENT DEVELOPMENTS IN THE THEORY OF WEAK INTERACTIONS. An Elementary Introduction to the Unified Gauge Field Model. Leite Lopes, J. (Centre National de la Recherche Scientifique, 67 – Strasbourg (France). Centre de Recherches Nucleaires). 1973. 49p. (In French). Dep. NTIS (U. S. Sales Only) $5.50.

An elementary description is given of the basic concepts in the theory of weak interactions: form and matrix elements of the weak current, quantum numbers of leptons and quarks, neutrino polarization states, intermediate vector bosons, and the current–current Lagrangian. The first attempts to unify weak and electromagnetic interactions as implicit in a relation between the electric charge and the coupling constant are recalled for the case of interactions between intermediate vector bosons and matter with a charge-independent Lagrangian. The unified gauge field model is described for the case of electrons and electron-neutrinos. The incorporation of muons into the model is discussed together with the difficulties encountered when attempting to introduce strange hadrons into the theory. (auth)

27918 (DESY-73-52) DETERMINING THE $K_S \to 3\pi$ AMPLITUDE IN $\bar{p}p$ (or e^+e^-) $\to K^0\bar{K}^0$. Dass, G. V. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Oct 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

The amplitude ratio $\langle 3\pi|T|K_S\rangle/\langle 3\pi|T|K_L\rangle$ can be well determined in e^+e^- (or low energy $\bar{p}p$) $\to K^0\bar{K}^0$ from the decay time-distribution when each produced kaon $\to 3\pi$, other unknown parameters of the distribution being obtainable from corresponding observations involving known channels like $\pi\pi$. (auth)

27919 (DESY-73-55) EFFECTIVE RANGE EXPANSION FOR ELECTRON–NEUTRINO AND ELECTRON–ANTINEUTRINO SCATTERING. Kramer, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Nov 1973. 35p. Dep. NTIS (U. S. Sales Only) $3.75.

Weak interactions from a pure S-matrix point of view are considered in order to get an idea about the high energy behavior. To have the weak interaction as undisturbed as possible by electromagnetic and strong interactions one studies only the leptonic processes $e\nu \to \nu e$, $e\bar{\nu} \to \bar{\nu}e$ and $e\bar{e} \to \nu\bar{\nu}$. The corresponding partial wave amplitudes are calculated for s and p waves and constrain them by low energy behavior coming from the lowest order approximation, analyticity and unitarity. Several examples of partial wave cross sections for the three reactions with resonant behavior in the $e\nu$ or $e\bar{\nu}$ channel are calculated numerically. (auth)

27920 (JINR-E2-7666) SPIN ANISOTROPIES IN THE PRODUCTION AND DECAY CORRELATIONS OF $X^0(960)$. Lednicky, R.; Ogievetsky, V. I.; Zaslavsky, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 12p. Dep. NTIS (U.S. Sales Only) $4.00.

There are 6 basic Adair distributions for two 3-particle $X^0(960)$-decay modes; in three of them the anisotropies in the recent Brookhaven $K^-p \to X^0\Lambda$ data at 2.18 GeV/c were observed. These anisotropies turned out to agree with the spin-parity 2^-. Values for three other anisotropies are predicted. The threshold effects were discussed also. (auth)

27921 (JINR-E2-7726) AUTOMODEL SOLUTIONS FOR MATRIX ELEMENTS OF CURRENTS IN CONFORMAL INVARIANT THEORIES. Matveev, V. A.; Robaschik, D.; Tavkhelidze, A. N.; Wieczorek, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 36p. Dep. NTIS (U. S. Sales Only) $5.00.

The equations were studied expressing conformal invariance for one-particle matrix elements of the product of two scalar or conserved vector currents. All solutions were found which are in accordance with causality, polynomial boundedness, and spectrum condition. The solutions are characterized by their automodel behavior in the Bjorken region. (auth)

27922 (JINR-P2-7686) NOTE ON THE DESCRIPTION OF MESON DECAYS IN THE THREE TRIPLET MODEL. Matveev, V. A.; Tolkachev, E. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 12p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

The description of lepton decays of mesons with one and three fundamental triplets is considered. It is shown that these decays do not allow one to discriminate between the models with different triplet numbers if the quark densities satisfy the universality condition $|\Psi_s(0)|^2 \sim (m_s/N)f_i$. (auth)

27923 (SLAC-167(Vol. 1), pp 71-82) PHENOMENOLOGICAL ANALYSIS, Part I. Inelastic Lepton Scattering With Polarized Beams and Targets. Gilman, F. J. (Stanford Linear Accelerator Center, CA). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9–28, 1973. Volume I.

A lecture is given on some of the theory and phenomenology related to inelastic lepton scattering with polarized beams and targets. Amplitude analysis, scaling, parton models, light cone algebra, sum rules, quark models for resonance excitation, and exotic J-plane singularity structure can be investigated with polarized beams and targets. (auth)

27924 (SLAC-167(Vol. 1), pp 93-99) ASYMPTOTIC BEHAVIOUR AND SHORT DISTANCE SINGULARITIES. Frishman, Y. (Stanford Linear Accelerator Center, CA). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9–28, 1973. Volume I.

The behavior of the structure functions for various short distance singularities is discussed. (auth)

27925 (SLAC-167(Vol. 1), pp 327-345) HADRONIC FINAL STATES IN INCLUSIVE LEPTO-PRODUCTION AND COLLIDING BEAMS, I. E. FEATURES OF CURRENT FRAGMENTATION. Colglazier, E. W. (Stanford Linear Accelerator Center, CA). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9–28, 1973. Volume I.

The features of current fragmentation in the parton model or the orthodox perspective are discussed using a previously developed version of this model. The assumptions and predictions and also the constraints and difficulties are primarily considered for inclusive lepton–lepton and lepton–hadron reactions with hadronic final states. (JFP)

27926 (SLAC-167(Vol.2), pp 35-76) PHENOMENOLOGY OF WEAK DECAYS. Wojcicki, S. (Stanford Linear Accelerator Center, CA). Nov 1973.

In Proceedings of Summer Institute on Particle Physics, July 9–28, 1973. Volume II.

Review lectures are given on the present status of weak decays emphasizing the relation of existing experimental data to current theoretical ideas. The more recent results are emphasized. (JFP)

27927 NEUTRINO AND WEAK INTERACTIONS. de Latil, P. Sci, Avenir; No. 321, 1020-1025(Nov 1973). (In French).

A new family of neutrino interactions was established at CERN: the existence of neutral currents in neutrino collisions. This discovery tends to simplify fundamental physics by establishing a correspondence between weak and electromagnetic interactions. (auth)

27928 y AND ν DISTRIBUTIONS FOR NEUTRAL CURRENT REACTIONS OF THE WEINBERG TYPE. Albright, C. H. (CERN, Geneva). Nucl. Phys.; B70: No. 3, 486-500(1974).

The y and ν distributions for inclusive neutrino and antineutrino reactions arising from a neutral current of the Weinberg-type are investigated in the framework of two quark parton models. While the ν distributions appear of little use at present, it is shown that by making a cut in the y variable, one can determine $\sin^2\theta_W$ reasonably accurately, independent of the cross section determination, even with the present narrow-band dichromatic neutrino beam at NAL. (auth)

27929 RADIATIVE CORRECTIONS TO THE MUON POLARIZATION IN $K^0_{\mu 3}$ DECAYS. Ginsberg, E.S. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Smith, J. Phys. Rev. D 8: No. 11, 3887-3894 (1 Dec 1973).

Radiative corrections to the muon polarization vector in $K^0_{\mu 3}$ decays have been calculated, based on a phenomenological weak K–π vertex

and perturbation theory. All terms which contribute to order α have been retained, with no approximations concerning the smallness of the muon mass or the "real" inner bremsstrahlung. The results depend logarithmically on a cutoff, but are not particularly sensitive to variations between one and two proton masses. The radiative corrections to the three components of the polarization vector (longitudinal, transverse, and perpendicular) have been evaluated numerically at 10-MeV intervals throughout the Dalitz plot, for various complex values of ξ. In addition, the integrated radiative correction to the degree of polarization as a function of muon energy has also been computed. It is found that these corrections are generally small, less that 1% degree of polarization in magnitude. (auth)

27930 FIELD-THEORETIC CALCULATION OF THE DIRECT-EMISSION AMPLITUDE IN $K^{\pm} \to \pi^{\pm}\pi^0\gamma$. Dominguez, C.A.; Zepeda, A. (Departamento de Fisica, Centro de Investigación y de Estudios Avanzados del Instituto Politecnico Nacional, Apartado Postal 14-740, Mexico 14, D.F.). Phys. Rev. D 8: No. 11, 4203-4205 (1 Dec 1973).

We show that to order eg^2G the direct-emission amplitude in the decay $K^{\pm} \to \pi^{\pm}\pi^0\gamma$ is logarithmically divergent. (auth)

27931 K_{l3} DECAYS IN A TWO-COMPONENT THEORY OF PARTIALLY CONSERVED AXIAL-VECTOR CURRENT. Newmeyer, J.L.; Drell, S.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8: No. 11, 4070-4075 (1 Dec 1973).

K_{l3} decays are discussed in an explicit model of PCAC (partially conserved axial-vector current) involving the pion and a heavier particle, the π'. This model has recently been shown to be capable of yielding the correct $\pi^0 \to 2\gamma$ decay rate from the Adler PCAC anomaly using one triplet of fractionally charged Gell-Mann-Zweig quarks, as well as reproducing all the "good" results of strong PCAC. In this paper we extend the model to treat K_{l3} decays and compare it to the earlier Brandt-Preparata theory of weak PCAC. (auth)

27932 RENORMALIZABLE SU(3) × SU(3) MODEL OF THE WEAK INTERACTION. Isgur, N. (Department of Physics, University of Toronto, Toronto, Canada). Phys. Rev. D 8: No. 11, 4166-4176 (1 Dec 1973).

A new model of the weak interaction is presented. The renormalizable model, which is based on an SU(3) × SU(3) intermediate scalar boson coupling scheme, reproduces the successes of the standard (V - A) theory for leptonic and semileptonic processes. Hadronic $\Delta Y = 1$ processes arise in the model exclusively from finite one-loop diagrams and obey an exact octet rule. The analogous $\Delta Y = 0$ graphs renormalize the quark masses to give finite mass differences within isotopic spin multiplets; when added to the electromagnetic mass differences within multiplets, this effect gives a good account of these mass splittings. (auth)

27933 COMMENT ON OCTET DOMINANCE. Gavroglu, K. (Department of Theoretical Physics, Imperial College, London, SW 7, England); Scadron, M.D.; Thebaud, L.R. Phys. Rev. D 8: No. 12, 4652-4654 (15 Dec 1973).

We demonstrate that the octet-dominance, chiral limiting procedure of Li and Pagels as applied to the semistrong Hamiltonian cannot be extended to the current-current model for the weak nonleptonic Hamiltonian. (auth)

27934 NEUTRINO ELECTRON SCATTERING IN THEORIES WITH NEUTRAL CURRENTS. Sehgal, L. M. (Technische Hochschule, Aachen). Nucl. Phys.; B70: No. 1, 61-69(1974).

Elastic neutrino electron scattering is considered in a general class of theories containing both charged and neutral currents. Assuming μ-e symmetry, the following results are proved. $\sqrt{\sigma(\nu_e e)} + \sqrt{\sigma(\nu_\mu e)} \geq \sqrt{2}$, $\sqrt{\sigma(\bar{\nu}_e e)} + \sqrt{\sigma(\bar{\nu}_\mu e)} \geq \sqrt{2/3}$, $\sigma(\bar{\nu}_e e) - \sigma(\bar{\nu}_\mu e) = \frac{1}{2}[\sigma(\nu_e e) - \sigma(\nu_\mu e)]$, $|[\sigma(\nu_e e) - \frac{1}{2}\sigma(\bar{\nu}_e e)]^{\frac{1}{2}} \pm [\sigma(\nu_\mu e) - \frac{1}{2}\sigma(\bar{\nu}_\mu e]^{\frac{1}{2}}| = \frac{1}{3}$, (where cross sections are in units of $G^2 m E_\nu/\pi$). Constraints are derived on the energy spectrum of the recoil electron. The Weinberg-Salam theory and the V-A theory are considered as special cases. (auth)

27935 POLARIZATIONS IN THE QUASI-ELASTIC NEUTRINO REACTION IN DEUTERIUM. Tarrach, R. (Univ., Barcelona, Spain). Nucl. Phys.; B70: No. 1, 70-82(1974).

The longitudinal and perpendicular polarizations of the energetic proton of the process $\nu_\mu + d \to \mu^- + p + p$ are studied using the impulse approximation. The sensitivity of the polarization parameters to the second class axial current and to variations in the parameter M_A of the axial form factor is considered. The influence of the second class axial current turns out to be relevant. (auth)

27936 VECTOR-AXIAL VECTOR INTERFERENCE TERMS IN INELASTIC NEUTRINO REACTIONS EXTRAPOLATED FROM SINGLE-PION PHOTOPRODUCTION. Suzuki, M. (Univ. of California, Berkeley). Nucl. Phys.; B69: No. 2, 413-425(1974).

By use of the generalized scaling sum rules the vector-axial vector interference terms in the scaling limit of the inelastic neutrino reactions are calculated from the absorptive parts of the single-pion photoproduction amplitudes at zero momentum transfer. The photoproduction amplitudes are evaluated by use of the results of multipole analysis. With the optimum values for the two parameters of the generalized scaling as determined in previous works, obtained $F_3^{\nu N}(\omega)$ was obtained which leads to good agreement with experiment in the ratio of $\sigma^{\bar{\nu}N}/\sigma^{\nu N}$. However, the zeroth moment in $x(= 1/\omega)$, $\int_0^1 dx(F_3^{\bar{\nu}p} + F_3^{\nu p})$ turns out to be smaller than half of the value predicted in the fractionally charged quark model. (auth)

27937 CHARGE ASYMMETRY IN THE $\mu^{\pm}$-NUCLEUS COLLISION AS A TEST FOR THE NEUTRAL WEAK CURRENT. Suzuki, M. (Univ. of California, Berkeley). Nucl. Phys.; B70: No. 1, 154-160(1974).

The effect of the neutral weak current can be detected in the inelastic $\mu^{\pm}$-nucleus collisions through the Q^2 dependence of the charge asymmetry in the cross sections. The asymmetry is estimated for the four-quark model of Weinberg by use of the experimental data on the muonless neutrino processes. The effect may be as large as $2 \sim 3\%$ in the large Q^2 region accessible at NAL. (auth)

27938 FORM FACTORS IN THE $K^0_{\mu 3}$ DECAYS. Dubna-Berlin-Budapest-Prague-Serpukhov-Sofia Collaboration. Phys. Lett.; 48B: No. 4, 393-396(18 Feb 1974).

The analysis of 82386 selected $K_{\mu 3}$ decays was performed. Two solutions both for the vector and scalar form factors were obtained, and for each solution the validity of linear approximation is shown. One of the solutions which agrees with the μ-e universality hypothesis gives the following values for the linear expansion parameters: $\lambda_+ = 0.046 \pm 0.008$, $\lambda_0 = 0.024 \pm 0.011$. (auth)

27939 GAUGE THEORIES AND ELASTIC WEAK NEUTRAL CURRENTS. Pais, A. (Rockefeller Univ., New York). Phys. Lett.; 48B: No. 4, 326-328(18 Feb 1974).

For the gauge group O(4) × U(1), the alternatives: left-handed leptons are (a) 4-spinors, (b) 4-vectors are shown to imply (a) possible presence, (b) absence of elastic ν_μ-e and ν_μ-nucleon amplitude to O(G). Some properties of the new spinor model are described. It contains a neutral current closely akin to the one in the Salam-Ward-Weinberg model. (auth)

27940 LEPTON CHARGE AND μ-e TRANSITIONS IN GAUGE MODELS OF WEAK INTERACTIONS. Nikolaev, N. N.; Shmatikov, M. Zh. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 19: No. 2, 360-365(Feb 1974). (In Russian).

A gauge model of weak interactions is proposed and $\mu^{\pm} \to e^{\mp}$ transitions, predicted by the model, are discussed. The estimates are given for $\mu^{\pm} \to e^{\mp}$ transitions on hadrons like $K^+ \to \pi^-\mu^+e^+$ with $\Gamma(K^+ \to \pi^-\mu^+e^+) \simeq 10^{-11}\,\Gamma(K^+)$ and for μ^--capture on nuclei with $W(\mu^- \to e^+) \simeq 10^{-12}\,W(\mu^- \to \nu)$. Single $\mu^{\pm}$ production in $e^{\mp}$ beams with cross sections $\sigma \sim 10^{-41}$-10^{-42} cm^2 is predicted. (auth)

27941 NON-HAMILTON THEORY OF NEUTRAL K MESON. Marinov, M. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 19: No. 2, 350-359(Feb 1974). (In Russian).

The conventional approach to description of the time evolution of the $K^0\bar{K}^0$ system is the Schroedinger equation for the two-component wave function. An alternative way is presented based on a general (noncommutator) linear equation for the density matrix. It is shown that such approach results in a consistent description of the system. The noncanonical terms may be of about 10% of the CP-violating terms. The modificated theory may be interesting in view of the $K^0_L \to 2\mu$ decay paradox. (auth)

27942 PROPERTIES OF POSSIBLE COMPOSITE LEPTON STATES INDUCED BY NEUTRINOS. Budini, P. (International Centre for Theoretical Physics, Trieste); Furlan, P. Nuovo Cim.; 20A: No. 1, 1-26(1 Mar 1974).

In the hypothesis that the long-range forces due to exchange of neutrino pairs between leptons remain unaltered up to distances of the order of the square root of the Fermi coupling constant, the possibility of existence of lepton-antilepton massless vector bound states is considered and studied with a Bethe-Salpeter equation in the ladder approximation. The equation is reduced to a system of coupled Fredholm integral equations for the spectral function of the vertex free-lepton-bound-state. In the zero-order approximation the form factor of the vertex is given and the effective renormalized coupling constant computed. It turns out to be rather insensitive to the dependence of the neutrino forces from the distance near the origin (with exception of the Coulomb dependence) and in this approximation it results

about 7 times larger than the electric one. This result is interpreted as an indication that also for leptons the electromagnetic vertex must be conceived as belonging to a higher symmetry invariant vertex. (auth)

27943 POMERON IN DEEP INELASTIC LEPTON–HADRON SCATTERING. Kim, B. R.; Rodenberg, R.; Schlereth, H. (Technische Hochschule, Aachen). Nuovo Cim.; 20A: No. 1, 156–168 (1 Mar 1974).

Within the framework of Harari's conjecture and the constraints provided by duality the consequences of a non-SU_2 singlet pomeron in deep inelastic lepton-hadron scattering are investigated. The corresponding distribution functions of the quark-parton model are discussed. (auth)

Strong (General)

27944 (DESY-73-60) ASYMMETRY IN PERIPHERAL PRODUCTION PROCESSES. Weiner, R. M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg, (F. R. Germany)). Dec 1973. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

As a consequence of local excitation an asymmetry with respect to the leading particle in peripheral production processes is predicted. It is interpreted in terms of heat propagation in hadronic matter (h.m.). (auth)

27945 (INIS-mf-1018) POSSIBLE ORIGIN OF SPRING FORCE QUARK OSCILLATOR MODEL. Ito, D. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). Mar 1972. 6p. INIS.

A possible origin of the spring force in quark models is investigated by means of a quark pair creation mechanism. The force between the constituent quarks is superstrong and of short range, but by means of quark pair creation a certain number of virtual mesons are created thus reducing the work made in separating a quark, as it is assumed that the force between the meson and the core is not so strong. By making simple assumptions on the probability of quark pair creation and on the dependence of the mean number of virtual mesons with the separation of a quark from the core, one gets a harmonic oscillator equation of motion for this quark. Meson production in high energy collisions is also investigated. (auth)

27946 (INP-848) CORRELATIONS IN NON-DIFFRACTIVE PRODUCTION PROCESSES AT HIGH ENERGIES. Bartke, J. (Institute of Nuclear Physics, Krakow (Poland)). 1973. 26p. (CONF-730680-1). Dep. NTIS (U. S. Sales Only) $3.50.

From international seminar on deep inelastic and multiple processes at high energies; Dubna, USSR (7 Jun 1973).

Recent papers concerning the "two-component" model of particle production indicate that strong correlations are needed in nondiffractive production processes in order to describe the observed multiplicity spectrum. It can be shown, however, that a wide class of models proposed so far to describe "pionization" do not yield sufficiently strong correlations. (auth)

27947 (SLAC-167(Vol. 1), pp 347-354) SCATTERING AT NOT-SO-LARGE MOMENTUM TRANSFERS. Blankenbecler, R. (Stanford Linear Accelerator Center, CA). Nov 1973.

In proceedings of Summer Institute on Particle Physics, July 9–28, 1973. Volume I.

It is shown that the constituent interchange theory allows one to derive relations between form factors and exclusive scattering at large angles and to connect these in a unified and simple manner to the Regge regions near the forward and backward direction. Both exclusive and inclusive scattering can be treated. Those rare and atypical events which depend on the detailed short-range behavior and also the most likely type of strong interactions are considered. (JFP)

27948 (SLAC-167(Vol.2), pp 265-275) NON-LAGRANGIAN APPROACH TO GAUGE-THEORIES AND HADRON PHYSICS. Weinstein, M. (Stanford Linear Accelerator Center, CA). Nov 1973.

In Proceedings of Summer Institute on Particle Physics, July 9–28, 1973. Volume II.

The treatment of a non-Lagrangian approach to gauge theories and hadron physics covers a review of PCAC as a hadron symmetry, a question that this raises about the peculiar relation that such an interpretation of PCAC implies between hadron physics and phenomenological ideas about weak and electromagnetic interactions, and an argument that a certain class of Higgs-type theories provides one with a natural answer to this question. (JFP)

27949 DECAY LAW OF UNSTABLE STATES. Mostowski, J. (Inst. of Physics, Warsaw); Wodkiewicz, K. (Univ. of Warsaw). Postepy Fiz.; 24: No. 6, 631-643(1973). (In Polish).

The validity of the exponential decay law is discussed in some detail. The deviations from the exponential decay law are studied in two ways: in a phenomenological one assuming the existence of a so called memory function, and in the framework of quantum field theory. The interpretation of the nonexponential decay law is also briefly discussed. (auth)

27950 CURRENT ALGEBRA AND GAUGE THEORIES. II. NON-ABELIAN GLUONS. Weinberg, S. (Harvard University, Lyman Laboratory of Physics, Cambridge, Massachusetts 02138 (Received 27 August 1973)). Phys. Rev. D 8: No. 12, 4482-4498 (15 Dec 1973).

The considerations of the first paper in this series are extended to non-Abelian gauge models of the strong, weak, and electromagnetic interactions. It is shown that for a large class of such theories, the strong interactions naturally conserve parity and strangeness, and possibly isospin and other quantum numbers as well. The corrections of second order in gauge couplings to such natural symmetries are convergent. In addition to the ordinary photon-exchange term, these corrections include other terms of order α, which take the form of shifts in the effective quark mass matrix, and which automatically conserve parity and strangeness. In theories with free-field asymptotic behavior, these order-α mass shifts may be correctly calculated ignoring all effects of the strong interactions. It is suggested that in such theories, the strong gauge group is not broken, and that the infrared divergences associated with the massless vector gluons prevent the production of quarks or gluons in collisions of ordinary hadrons. (auth)

27951 HOW DO STRINGS RADIATE?. Willemsen, J.F. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8: No. 12, 4457-4478 (15 Dec 1973).

An invariant regulator field method is applied to the construction of vector-current vertices in a dual resonance model. If it is not required that the regulators be fully conformally-invariant, but only that they have the invariance required for duality, Gaussian factors can be eliminated consistently from both the elastic form factor and the deep-inelastic structure functions. This method introduces new ghost states which can be pushed to arbitrarily large mass by judicious choice of the regulator parameters. However, there are still ghosts at low levels from the basic dynamical oscillator field, as in the Veneziano model with intercept $\alpha(0) = 1$. The structure function νW_2 does not scale in the model. The physical interpretation of this result is discussed in detail. (auth)

27952 MODEL OF NONSTRANGE CURRENTS AND MESONS. Susskind, L.; Casher, A. (University of Tel-Aviv, Ramat Aviv, Tel-Aviv, Israel); Kogut, J. Phys. Rev. D 8: No. 12, 4448-4456 (15 Dec 1973).

We introduce SU(2) vector and axial-vector currents into the two-dimensional world sheet of the dual resonance model. The currents satisfy the constraints of current algebra and chiral symmetry. The pion appears as a Goldstone boson and multipion amplitudes satisfy all current-algebra theorems. The normal modes describing the propagation of currents through the hadronic medium carry the quantum numbers of nonstrange quarks. The model suggests that the order of magnitude of total cross sections is given by f_π^{-2}, the square of the inverse of the pion decay constant ($f_\pi \simeq 190$ MeV), as suggested by Pagels. Although π–A_1 and ρ–f^0 exchange degeneracy must be imposed artificially, the resulting restricted model retains all the good properties mentioned above. (auth)

27953 POSITIVITY CONDITIONS AND FRAMPTON'S DUAL MODELS. Balachandran, A.P.; Rupertsberger, H. (Physics Department, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 8: No. 12, 4528-4531 (15 Dec 1973).

Gribov and Pomeranchuk and also Martin have derived positivity conditions on scattering amplitudes which are necessary conditions for the absence of ghosts. We show that they are fulfilled by one of the models proposed by Frampton for physically acceptable trajectories and external masses. We also show that they are not fulfilled by another such model, which therefore has ghosts. (auth)

27954 EXPERIMENTAL SUPRESSIONS OF RESONANCE COUPLINGS AS GAGUGE-LIKE CONDITIONS FROM DUAL RESONANCE MODELS. Odorico, R. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 8: No. 11, 3952-3979 (1 Dec 1973).

The paper deals with the observed phenomenon of dynamical suppression of a number of resonance couplings [f^0 (1520) $\pi\pi$, K^{**} (1420)$K\eta$,etc.], new instances of which keep appearing as data accumulate. A few of such effects have been conventionally understood in terms of the quark model, which is however inadequate to account for all of them. We consider a specific dual resonance model, which is suggested by the approximate linearity in the (s, t, u) plane observed for the zero trajectories of certain two-body amplitudes. Relevant experimental evidence concerning zero behavior has been already discussed else-where; we present here a short and updated review of it. We show that such a dual model predicts in a natural way many of the observed coupling suppressions, and possibly—once generalized—all of them. It also accounts partially, in an analogous manner, for the

decoupling of exotic resonances. The way in which the dual constraints of the model and the resonance decouplings are interrelated exhibits a structural similarity with the well-known interconnection between charge conservation and decoupling of longitudinal photons in electromagnetic interactions. The model is supposed to apply in its present form only to amplitudes in which linearity of zeros is observed, but there are elements to argue that dual constraints of the same nature are active in any hadronic amplitude. Central in obtaining the results is the interplay of the dual model and unitary symmetries, which is much stronger than in conventional dual models, where such symmetries intervene only externally through Chan-Paton factors. (auth)

27955 RELATIONS BETWEEN LARGE-ANGLE SCATTERING, FORM FACTORS, AND STRUCTURE FUNCTIONS. Fishbane, P.M. (Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11790); Muzinich, I.J. Phys. Rev. D 8: No. 11, 4015-4033 (1 Dec 1973).

We study the large-momentum-transfer limit of electromagnetic form factors and the high-energy, large-momentum-transfer limit of exclusive and inclusive scattering under the physical approximation that hadronic states are composite systems which can be decomposed in this kinematic regime into two finite mass and spin constituents. One of these constituents (the parton), is pointlike in accordance with the results of deep-inelastic scattering, while the other (the core) is not. We study in this work only the constituent interchange contribution to scattering, as in a previous work by Gunion, Blankenbecler, and Brodsky. Our approach is to use a general, covariant decomposition of the composite-particle vertex, and then to study relations between the form factors and scattering amplitudes. Rather than taking a phenomenological approach, our aim is to make a careful study of the theoretical underpinnings of such relations. We find that the Drell-Yan-West relation between elastic form factors and deep-inelastic structure functions holds in general, and that the inclusive cross section is proportional to a deep-inelastic structure function. The power dependence of the exclusive and inclusive cross section on elastic form factors is not uniquely determined and we classify various theories according to this dependence. Basically the reason for this is that the elastic and inelastic form factor sample the off-shell behavior of the composite system only in the parton momentum, whereas scattering amplitudes depend intimately on the off-shell behavior of the hadronic vertex in both the core and parton. We also examine a noncovariant integral equation first given by Weinberg to study these problems. (auth)

27956 WHY DOES THE POMERON LOOK SO SIMPLE IF IT IS REALLY SO COMPLICATED? Finkelstein, J. (Columbia University, New York, New York 10027). Phys. Rev. D 8: No. 11, 4176-4182 (1 Dec 1973).

The absorbed multiperipheral model is suggested as a vehicle for understanding the approximate constancy with energy of total cross sections that ultimately rise to saturate the Froissart bound. Two approximation schemes, which share as their lowest approximation a simple, factorizable Pomeron, are discussed. In a streamlined version of the model, an estimate of the squared energy s at which this simple picture breaks down is given by $\ln(s/s_0) = [\sigma_{\infty}/(4\pi\alpha')]^{1/3} \simeq 4.3$. (auth)

27957 MULTIPERIPHERAL PREDICTIONS FOR CHARGE-TRANSFER AND PRONG CROSS SECTIONS. Coulter, P.W.; Snider, D.R. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 8: No. 11, 4055-4061 (1 Dec 1973).

The relation between the charge transfer between hemispheres and the decrease of the n-prong cross section with energy is examined in several multiperipheral models and compared to preliminary experimental data. The data for charge transfer shows about equal amounts of neutral and charge transfer. Certain isospin-conserving models (the A and I models) fail to predict this, while other more general models simplify at this symmetry point. One of these new isospin models appears to be realistic. (auth)

27958 CAN WE MEASURE PARTON-PARTON CROSS SECTIONS?. Bjorken, J.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8: No. 11, 4098-4106 (1 Dec 1973).

Multiple-core production in hadron-hadron collisions directly measures (in the context of the parton model) differential cross sections for parton-parton collisions. To obtain ~ 20% accuracy in reconstruction of the parton-parton kinematics requires transverse momentum of the cores $\gtrsim$ 5 GeV/c. Experiments at NAL as well as the CERN ISR appear feasible. What might be learned from such studies is discussed. (auth)

27959 SCALING LAWS AT LARGE TRANSVERSE MOMENTUM. Brodsky, S.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Farrar, G.R. Phys. Rev. Lett. 31: No. 18, 1153-1156 (29 Oct 1973).

The application of simple dimensional counting to bound states of pointlike particles enables us to derive scaling laws for the asymptotic energy dependence of electromagnetic and hadronic scattering at fixed c.m. angle which only depend on the number of constituent fields of the hadrons. Assuming quark constituents, some of the $s\to\infty$, fixed-t/s predictions are $(d\sigma/dt)_{\pi p\to\pi p} \sim s^{-8}$, $(d\sigma/dt)_{pp\to pp} \sim s^{-10}$, $(d\sigma/dt)_{\gamma p\to\pi p} \sim s^{-7}$, $(d\sigma/dt)_{\gamma p\to\gamma p} \sim s^{-6}$, $F_\pi(q^2) \sim (q^2)^{-1}$, and $F_{1p}(q^2) \sim (q^2)^{-2}$. We show that such scaling laws are characteristic of renormalizable field theories satisfying certain conditions. (auth)

27960 ANALYSIS OF THREE-HADRON FINAL STATES. Aaron, R. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544); Amado, R.D. Phys. Rev. Lett. 31: No. 18, 1157-1159 (29 Oct 1973).

Unitarity implies a rapid variation (singularity) in an amplitude usually assumed to be slowly varying in simple pairwise final-state-interaction fits to three-body final states. Neglect of this singularity casts doubts on recent analyses of $\pi+N\to\pi+\pi+N$, among others. Tentative suggestions for including the singular term are offered. (auth)

27961 DECAY LAW OF UNSTABLE STATES. Mostowski, J.; Wodkiewicz, K. (Inst. of Physics, Warsaw). Bull. Acad. Pol. Sci.; Ser. Sci., Math., Astron. Phys.; 21: No. 11, 1027-1035(1973).

An outline of the Wigner-Weisskopf theory of unstable states is presented. Numerical analysis of the decay law is given, deviations from the exponential decay law are studied in some detail. The interpretation of the nonexponential decay law is also briefly discussed. (auth)

27962 THREE-BODY PROBLEM IN THE STRONG COUPLING THEORY. Semenov, S. V. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 18: No. 3, 353-366(Mar 1974). (In Russian).

The problem of three-particles interacting strongly with a scalar field is considered on the basis of N. N. Bogoliubov's method. Iterative scheme for evaluating the energy and wave function of the system is developed and the equation of the relative motion is obtained. The limiting case of this equation corresponding to the scattering problem is investigated. (auth)

27963 INTRODUCTION TO DUAL MODELS OF STRONG INTERACTIONS AND THEIR PHYSICAL MOTIVATIONS. Veneziano, G. (Weizmann Inst. of Science, Rehovot, Israel). Phys. Rep.; 9C: No. 4, 199-242(Feb 1974).

The report covers the following topics: a glance at strong interactions; difficulties in constructing a theory of strong interactions; resonance scattering and its range of validity; duality; construction of dual models; properties of the solutions; and further problems and outlook. (LBS)

27964 THERMODYNAMICAL VELOCITY FUNCTIONS AND ELASTIC SCATTERING. Celeghini, E.; Lusanna, L. (Instituto di Fisica Teorica, Florence). Nucl. Phys.; B69: No. 1, 58-76 (1974).

With a simple model of the interaction of two hadrons a critical discussion is given of the velocity weight function of the thermodynamical model. It is shown that such a function depends on elastic scattering and so lies outside the conventional treatment of thermodynamics. The appearance of a square root divergence at $\lambda = 0$ is explained, but the model is too simple to reproduce the right elasticity of throughgoing particles and so the velocity function becomes energy dependent and too peaked at low velocities. (auth)

27965 STATISTICAL BOOTSTRAP WITHOUT EXOTIC STATES. Kripfganz, J.; Ilgenfritz, E. M. (Karl-Marx-Univ., Leipzig). Phys. Lett.; 48B: No. 4, 329-332(18 Feb 1974).

Fireball decay is studied in the framework of a linear statistical bootstrap model with full isospin conservation. The fireball isospin is restricted to the values 0 and 1. This restriction causes a modification of the temperature relation compared with the unrestricted case. The first few inclusive decay distributions, however, remain nearly unaltered. The asymptotic average multiplicities of π^+,π^0,π^- are found to be equal. (auth)

27966 JASTROW CORRELATIONS AND AN IRREDUCIBLE CLUSTER EXPANSION FOR INFINITE BOSON OR FERMION SYSTEMS. Fantoni, S.; Rosati, S. (Univ., Pisa, Italy). Nuovo Cim.; 20A: No. 1, 179-193(1 Mar 1974).

A cluster expansion for an infinite system of bosons or fermions is presented together with a diagrammatic representation and simple rules for writing the various terms. The expansion is shown to be linked and irreducible. The explicit expression so obtained is convenient for performing partial summations of terms associated with different orders of the expansion. (auth)

27967 SCALE DIMENSION OF CHIRAL-SYMMETRY BREAKING. Haan, O. (Univ. of Heidelberg); Nasrallah, N. F.; Schilcher, K. Nuovo Cim.; 20A: No. 1, 207-216(1 Mar 1974).

The scale dimension d of the scale and chiral-symmetry-breaking part u of the strong-interaction Hamiltonian density is estimated by using the Fubini-Furlan extrapolation procedure and the available experimental information on the s-wave, I = 0, π-π phase shifts and scattering lengths. The value $2.3 < d < 3.0$ is obtained. (auth)

Strong (Baryon No. = 0)

Refer also to abstracts 28059 and 28066.

27968 (JINR-P2-7660) LOCAL EXPRESSION FOR THE SPECTRAL FUNCTION OF THE MATRIX ELEMENT BETWEEN VACUUM [0] AND THE ONE BOSON STATE [v_γ,(p,q,ϵ_γ)] OF THE CURRENT COMMUTATOR [$V_\mu^a(x)$, $v_\nu^b(0)$]. Fakirov, D. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The local expression is found in an explicit form for the spectral function of the matrix element of the nonequal time commutator [$V_\mu^a(x)$, $V_\nu^b(0)$] between vacuum and one-particle boson state describing the vector (pseudovector) meson, $v_\gamma(p,\epsilon_\gamma)$ belonging to the octet of vector (pseudovector) mesons in SU(3) symmetry. Current densities of $V_\mu^a(x)$ and $V_\nu^b(x)$ also belong to the corresponding octets in SU(3) symmetry and these themselves or definite combinations of their unitary components are operators of physical quantities. This is in a direct correspondence with the requirement of local commutativity of current densities. In the given approach the locality is a natural consequence of the choice of the system of intermediate states saturating the commutator. In this way one obtains a number of so-called locality conditions, determined by the form of the singular part of the function in consideration. These conditions relate to the decay constants and residual ones (bound constants), corresponding to the processes in which bosons from the intermediate states and the initial vector meson are involved. (auth)

27969 (RL-73-155) TESTS OF $\pi\pi$ PHASE DETERMINATIONS. Morgan, D. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Jan 1974. 10p. Dep. NTIS (U. S. Sales Only) $4.00.

Simple tests are proposed to check or constrain $\pi\pi$ phase determinations from analysis of di-pion production: (a) Does the form of the output P wave phase shifts agree with expectation from analyticity and crossing? (b) Where amplitude analysis is used to separate different components of production, does the purported background to OPE veritably contain no OPE signal? (auth)

27970 IMPROVING THE CHIRAL ENERGY–MOMENTUM TENSOR. Charap, J. M. (Queen Mary Coll., London). J. Phys., A (London); 7: No. 1, 24-29(1 Jan 1974).

The energy-momentum tensor for a chiral-invariant theory of massless pseudoscalar mesons is "improved" by the methods of Callan, Coleman and Jackiw (Ann. Phys. N. Y.; 67: 552-98(1971)). The improved tensor has a simple relation to the dilation current and nonvanishing triple-derivative terms in the equal-time commutators of its components. (auth)

27971 PHYSICAL PION–PION PARTIAL-WAVE EQUATIONS BASED ON THREE CHANNEL CROSSING SYMMETRY. Mahoux, G. (CEN de Saclay, Gif-sur-Yvette, France); Roy, S. M.; Wanders, G. Nucl. Phys.; B70: No. 2, 297-316(1974).

A set of closed systems of partial-wave equations for pion-pion scattering valid for $-28\ m_\pi^2 \leq s \leq 125.31\ m_\pi^2$ is presented. These equations give the real part of a given partial-wave amplitude in terms of scattering lengths and a convergent series of integrals over the physical values of the absorptive parts of all partial waves. The equations are extensions of relations previously derived from fixed-t dispersion relations. The new equations are rigorous consequences of axiomatic analyticity and three channel crossing symmetry. As an application, the effect of the f^0-meson on the I = 0 S-wave is evaluated. (auth)

27972 REACTIONS OF ELECTROPRODUCTION OF SINGLE K^+ MESONS ON NUCLEONS NEAR THRESHOLD. Krive, I. V. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 12, 1994-1997(Dec 1973). (In Russian).

The reactions $e^-p \rightarrow e^-\Lambda(\Sigma^0)K^+$ near the threshold are considered within the frames of gradient invariant Born approximation. The model under study is shown to be in agreement with the experimental data for the cross sections ratio of electroproduction of Σ^0 and Λ-hyperons near the threshold. (auth)

27973 STATISTICAL APPROACH TO PARTON MODELS: APPLICATION TO 90° CROSS SECTIONS. Eilam, G.; Gell, Y. (Department of Physics, McGill University, Montreal 101, Quebec, Canada). Phys. Rev. D 8: No. 11, 3930-3937 (1 Dec 1973).

We present a parton statistical model in which the pairing interaction has been explicitly taken into account. Using a generalized equidistant model for the density of states we calculate the 90° differential elastic two-body cross section in terms of an incoherent sum of direct-channel resonances. Encouraging agreement with the data for π^+p and $p\bar{p}$ elastic reaction is obtained. Two main results are deduced from our analysis: (a) an approximate exponential decrease of $d\sigma/dt|_{90°}$; (b) a break structure in $d\sigma/dt|_{90°}$. The position of the break is fixed at the energy where the temperature of the system reaches its critical value, i.e., a phase transition occurs. (auth)

27974 GAUGE THEORIES BASED ON QUARKS AND THE η–3π PROBLEM. Mohapatra, R.N.; Pati, J.C. (Department of Physics and Astronomy, Center for Theoretical Physics, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 8: No. 11, 4212-4217 (1 Dec 1973).

If chiral $U(3)_L \times U(3)_R$ symmetry is broken only in the $(3,3^*) + (3^*,3)$ manner (ignoring weak and electromagnetic interactions), as is the case for the class of renormalizable gauge theories based on quarks and the simple quark-gluon model, then it is shown that the contribution of the U_3 term to the η–3π decay treated to all orders in perturbation theory leads to a grossly incorrect slope and perhaps a suppressed magnitude contrary to usual expectations. Exceptions to the above result might have arisen if either of the interesting relations $\sqrt{2}\epsilon_0 + \epsilon_8 = 0$ or $\sqrt{2}\epsilon_0 + \epsilon_8 = \pm\sqrt{3}\epsilon_3$ were satisfied exactly, which, however, does not seem to be permitted by nature. Thus ν–3π decay remains a major problem for the class of models mentioned above, even in the presence of the U_3 term. (auth)

27975 GAUGE MODEL FOR THE ELECTROMAGNETIC FORM FACTOR AND THE ρ' MESON. Fujikawa, K.; O'Donnell, P.J. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Silver Street, Cambridge, CB3 9EW, England). Phys. Rev. D 8: No. 11, 3994-3999 (1 Dec 1973).

Following the basic idea of the spontaneously broken gauge theory and ρ dominance and its universality, we propose a simple model for the ρ' meson. With the identification of the Higgs scalar meson with the ϵ meson, we are able to give a satisfactory description of various results in electron colliding-beam experiments. The pion form factor and the Dirac isovector form factor of the nucleon are identical in the present model, and they are in agreement with experiment. (auth)

27976 DUAL MODELS FOR FOUR-MESON BORN TERMS. Balachandran, A.P.; Rupertsberger, H. (Physics Department, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 8: No. 12, 4524-4527 (15 Dec 1973).

A general formula for a dual four-meson Born amplitude whose integrand is invariant under an S_3 permutation group is presented. (auth)

27977 DECAY RATES AND DISTRIBUTIONS FOR RESONANCES OF ANY SPIN. Avram, N. M.; Schiller, D. H. An. Univ. Timisoara, Ser. Stiinte Fiz.-Chim.; 8: No. 1, 5-13(1970).

The desintegration widths, the angular, and power distributions for (M^j) bosonic and $(N^{j+\frac{1}{2}})$ fermionic resonances of any spin and both parities are given and which desintegrate either at rest or in flight in two particles: $M^j \rightarrow \pi\pi, \rightarrow \gamma\pi, \rightarrow N\bar{N}$ and $N^{j+\frac{1}{2}} \rightarrow N\pi, \rightarrow \gamma N$. (Rom. Sci. Abstr.)

27978 TWO BODY REACTIONS AND THE QUARK MODEL. Dorren, J. D. (Eidgenoessische Technische Hochschule, Zurich). Nucl. Phys.; B69: No. 1, 34-57(1974).

A simple quark model for two-body hadronic amplitudes is presented and applied to $\bar{p}p$ (pp) and K^+p elastic scattering. Hadronic processes are described in terms of quark-quark scattering, using Glauber theory to take into account the effects of multiple scattering. Exchange degenerate Regge poles are introduced at the quark level. A predictive model for Regge cuts is obtained. It has some features in common with the dual absorption model in its correlation of dip structure and shrinkage in elastic processes with the exoticity of the s-channel but also significant differences, for example in the interpretation of the $\bar{p}p$ dip. The qualitatively different structure in the pp differential cross section is also reproduced. It breaks exchange degeneracy in a well defined way and in doing so offers an explanation of the differences between pp and K^+p total cross sections. The difference in their differential cross sections is a natural consequence of the model and structure similar to the pp structure is predicted to appear in the K^+p differential cross section in the region $t \approx -2(\mathrm{GeV}/c)^2$. (auth)

27979 INTERACTING-STRING PICTURE OF THE NEVEU–SCHWARZ–RAMOND MODEL. Mandelstam, S. (Univ. of California, Berkeley). Nucl. Phys.; B69: No. 1, 77-106(1974).

The interacting-string picture is extended to the Neveu–Schwarz and Ramond models. The picture is manifestly dual, even for the Ramond model, and amplitudes with an arbitrary number of external fermions can be constructed. In all channels

the only singularities are poles corresponding to the expected particles. There exist both $q\bar{q}$ and zero-quark mesons, which differ in the parity of the states with odd Neveu–Schwarz g-parity. Calculations of ff scattering amplitudes are performed. The results are B-functions multiplied by simple kinematical factors, and it is easily verified that the amplitudes possess all the necessary properties. (auth)

27980 ANGULAR MOMENTUM STATES IN ANTIPROTON–NUCLEON ANNIHILATIONS AT REST IN DEUTERIUM. Bizzarri, R.; Ciapetti, G.; Dore, U.; Gaspero, M.; Laakso, I.; Marzano, F.; Moneti, G. C. (Univ., Rome). Nucl. Phys.; B69: No. 2, 298–306(1974).

The effect of the Fermi motion on the angular momentum states of antiproton-nucleon annihilation at rest in deuterium. For annihilations from S-orbitals important contribution of the P-wave in the pN system with a peculiar shape of the "spectator" momentum spectrum is found. A cut on the spectator momentum can therefore reduce this contribution to a very small level. (auth)

27981 ISOSPIN-TWO $\pi\pi$ PHASE SHIFTS FROM AN EXPERIMENT $\pi^+p \rightarrow \pi^+\pi^+n$ AT 12.5 GeV/c. Hoogland, W. (Univ., Amsterdam); Grayer, G.; Hyams, B.; Jones, C.; Weilhammer, P.; Blum, W.; Dietl, H.; Koch, W.; Lorenz, E.; Luetjens, G.; Maenner, W.; Meissburger, J.; Stierlin, U. Nucl. Phys.; B69: No. 2, 266–278(1974).

The I = 2 s-wave and d-wave phase shifts δ_0^2 and δ_2^2 were determined in the $\pi\pi$ mass region 0.5 to 1.5 GeV/c^2 in four mass bins of width 0.25 GeV/c^2, using a sample of 17 500 events from a wire chamber experiment. Two different methods were used, leading to consistent results. In the ρ-mass region $\delta_1^1 \simeq 15.5°$, which corresponds to an elastic cross section of ≃7.5 mb. The values of δ_0^2 are about a factor of ten smaller than the corresponding values of δ_1^1. (auth)

27982 QUARK DYNAMICS AND STRONG MESON DECAYS. Boehm, M. (CERN, Geneva); Joos, H.; Krammer, M. Nucl. Phys.; B69: No. 2, 349–371(1974).

The strong decays of meson resonances are treated in a dynamical quark model. The model is formulated in the framework of general field theory and therefore all calculations are fully relativistic covariant. Spectrum and wave functions are derived from a Bethe–Salpeter equation describing the binding of heavy quarks by a smooth, very strong interaction. The mesonic vertices are calculated with help of these BS amplitudes in triangle graph approximation, thereby guaranteeing a symmetric treatment of all mesons involved in the process. A particular spin dependence of the interaction has the consequence that the super-strong quark binding forces lead to mesonic forces of moderate strength only (saturation of quark forces!). The applications refer to the decays of vector mesons, tensor mesons, scalar mesons into pseudoscalars and vectors and are extended to resonances in the R region. In particular, we include the decays into two pions of the radial excited $\rho'(1600)$. The helicity structure of the decays of the axial vector meson is discussed. (auth)

27983 RELATIVISTIC DECAY THEORY: CORRECTIONS TO THE WEISSKOPF–WIGNER APPROXIMATION. Parkinson, M. T. (Univ. of Florida, Gainesville). Nucl. Phys.; B69: No. 2, 399–412(1974).

An analysis is undertaken of the corrections to the Wigner-Weisskopf approximation for relativistic decay processes. It is shown that difficulties with relativistic invariance are encountered. A proposal is made for a Lorentz invariant approximation which preserves as much of the original expression as possible. The effects of measurements are discussed, and it is noted that, indeed, a watched pot cannot boil. Curves are presented for a hypothetical $\rho \rightarrow \pi\pi$ decay process, and the deviations from exponentiality are discussed when measurements both are and are not being made. (auth)

27984 WIDTH OF THE f MESON, CROSSING SUM RULES, AND THE POMERON. Grassberger, P. (Univ., Bonn). Nucl. Phys.; B70: No. 1, 141–153(1974).

Sum rules on pseudoscalar meson–meson scattering amplitudes in the physical region are studied. The main conclusions are: The too narrow width of the f meson obtained in dual models is related to the absence of a pomeron in these models and, vice versa, a pomeron may not be added to a crossing-symmetric amplitude without changing the f width. Numerically, a width of about 200 MeV, as found in a recent high statistics $\pi\pi$ phase shift analysis, is preferred. The singlet/octet ratio for the tensor meson couplings is larger than predicted e.g., by the U(3) quark model. (auth)

27985 NEW PARAMETRIZATION OF THE DIFFERENTIAL CROSS SECTION FOR ELASTIC SCATTERING. Dumbrais, O. V. (Inst. Rudjer Boskovic, Zagreb); Chernev, K.; Zlatanov, Z. Nucl. Phys.; B69: No. 2, 336–348(1974).

A new parametrization of the differential cross section for elastic scattering is proposed. The parametrization incorporates correct analytic properties of the differential cross section and is based on optimized polynomial expansions of an analytic function. It is, in principle, valid for all energies and all angles. The parametrization was tested for pp, $\bar{p}p$, pd, $\pi^\pm p$ and $K^\pm p$ elastic scattering at high energies and small angles. The results of the new fits are compared with those of the old ones. It was found that with the same number of parameters one obtains practically the same values of χ^2. However, the new values of physical quantities, such as slope, α and $(d\sigma/dt)_0$, in most cases differ considerably from those obtained by the old parametrization. In particular, it was found that the slope of the differential cross section for pp, $\bar{p}p$, pd and $K^\pm p$ elastic scattering increases continuously as the forward direction is approached. (auth)

27986 SPECTRAL FUNCTION SUM RULES AND HIGHER MASS VECTOR MESONS. Pocsik, G. (Eotvos Lorand Tudomanyegyetem, Budapest). J. Phys., A (London); 7: No. 1, 30–34 (1 Jan 1974).

Contributions of the ρ' meson are computed to various spectral function sum rules. The possible existence of higher-mass axial vector mesons, isoscalar vector mesons and the importance of the higher-mass continuum are concluded. (auth)

27987 COMPARISON OF THE REACTION $\bar{p}p \rightarrow K^0\bar{K}^0$ AT REST IN HYDROGEN AND DEUTERIUM. A Test of S-state Annihilation Dominance. Bizzarri, R.; Ciapetti, G.; Dore, U.; Gaspero, M.; Laakso, I.; Marzano, F.; Moneti, G. C. (Univ., Rome). Nucl. Phys.; B69: No. 2, 307–316(1974).

From the comparison of the frequency of antiproton annihilation at rest in two mesons in H_2 and D_2, the dominance of S-wave in $\bar{p}p$ annihilation at rest is confirmed, the P-wave contribution being less than 6% at the 95% confidence level. The apparent discrepancy between the channels $\bar{p}p \rightarrow K^0\bar{K}^0$ and $\bar{p}p \rightarrow \pi\pi$ is due to the strong dependence of the annihilation dynamics from the angular momentum. (auth)

27988 CONFORMAL WARD IDENTITIES AND THE PION MASS RADIUS. Dao Vong Dyk. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 2, 424–430(Feb 1974). (In Russian).

The π-meson mass form factor and its derivatives are considered in the framework of the conformal invariance. The method used is based on the Ward identities derived from the T-products including the gauge and conformal currents. The π-meson mass radius is estimated. (auth)

27989 EXTRAPOLATION TECHNIQUES AND THE PION FORM FACTOR. Kellett, B. H. (Univ. of Glasgow); Verzegnassi, C. Nuovo Cim.; 20A: No. 1, 194–206(1 Mar 1974).

The possibility of applying optimal extrapolation techniques to the determination of the pion form factor from charged-pion electroproduction is discussed. With the data available at present, the uncertainty in the pion form factor is very large. It is suggested that the use of some additional information in the unphysical region might be useful. As an example, a well-known kinematical constraint is used in conjunction with threshold electroproduction data to determine the pion form factor at a timelike momentum transfer of approximately one fm^{-2}. Some implications of this model-independent determination of the form factor for the pion charge radius are discussed. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 28064, 28073, and 28358.

27990 (JINR-P1-7696) SIMULATION OF INCLUSIVE PROCESSES. Kopylov, G. I.; Penev, V. N.; Shklovskaya, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 16p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

In order to apply the Monte-Carlo method for inclusive reaction, it is sufficient to regard it as a sum of exclusive reactions each of which can be simulated with the help of existing programs (FORS, FOWL, MULTIFORS). The reaction $\pi p \rightarrow \pi$ + anything at 40 GeV/c is simulated; it is assumed that each of reactions $\pi p \rightarrow N + n\pi$ (n from 1 to 18) can be described by multiperipheral diagrams; the program MULTIFORS is used to simulate them. The diagrams are added with the weights proportional to the experimentally observed multiplicities (of charged particles plus the mean number of neutral particles). The sign of mesons was not taken into account. The results of comparison with experimental data are discussed. (auth)

27991 TRUE MULTIPLICITY DISTRIBUTION IN K^-p INTERACTIONS AND THE TWO-COMPONENT MODEL. Deutschmann, M. (Technische Hochschule, Aachen); Graessler, H.; Kirk, H.; Otter, G.; Albrecht, K. F.; Schreiber, H. J.; Cocconi, V. T.;

Counihan, M. J.; Hansen, J. D.; Karimaeki, V.; Kellner, G.; Morrison, D. R. O.; Stroynowski, R.; Wahl, H.; Dornan, P. J.; Schmid, P.; Thornton, P. R.; Girtler, P.; Kisielewska, D.; Markytan, M. Nucl. Phys.; B70: No. 2, 237-256(1974).

A method is presented for deriving channel cross sections for all multiplicities, considering both charged and neutral particles, for K^-p reactions of pion production. Thus the "true", rather than charged, multiplicity is obtained. The input data are the channel cross sections measured with four- and one-constraint fits. The model employed is the two-component one, so that for each reaction channel, separate cross sections are derived for kaon diffraction, proton diffraction and for non-diffractive processes. Results are obtained up to the highest energies at which data of channel cross sections are available, i.e., up to 16 GeV/c incoming momentum, and some extrapolation is also made towards higher energies. It is found that the cross section for single kaon diffraction dissociation is equal to that for single proton diffraction dissociation. In the energy range considered, the sum of kaon and proton single diffraction processes has a cross section of (2.4 ± 0.3) mb, i.e., about 75% of the elastic cross section. The cross section for kaon diffraction dissociation into ($K\pi$) is consistent with zero. (auth)

27992 MODEL FOR THE REACTION KN → QN. Athens-Democritus-Liverpool-Vienna Collaboration. Nucl. Phys.; B70: No. 3, 365-378(1974).

A model for the reactions Kp → Qp is given assuming dominance of pomeron and ω, f exchanges. The coupling of the pomeron is taken in accord with s-channel helicity conservation (SCHC) and both real and imaginary parts of the SCH amplitudes for ω and f exchange have a t-structure in accord with amplitude analyses. The model was fitted to the 8.2 GeV/c K^-p and 7-9 GeV/c K^+p data and is seen to describe satisfactorily the $d\sigma/dt$ and $(d\sigma/dt)\rho_{ij}$ distributions. A cross-over is predicted at $|t'| = 0.18 \pm 0.03$ which is consistent with experimental data. The energy dependence of the cross section predicted for $4 < P_{lab} \leq 14$ GeV/c is in good agreement with experimental data of K^+ and K^0. The model predictions concerning s- and t-channel helicity conservation are in good agreement with current experimental data while the model predicts that for beam momenta higher than 30 GeV/c, SCHC should be apparent in all the reactions $K^+p \to Q^+p$, $K^0p \to Q^0p$ and $\bar{K}^0p \to \bar{Q}^0p$. (auth)

27993 BARYON DUALITY SOLUTIONS WITH THE HARMONIC OSCILLATOR SPECTRUM AND THE AMPLITUDE SIGNS IN $\pi N \to \pi\Delta$. Eguchi, T. (Tokyo Univ.). Nucl. Phys.; B70: No. 3, 390-396(1974).

By constructing exact exchange-degenerate solutions of baryons with the harmonic-oscillator spectrum for a set of reactions MB → M'B', MB → M'D' and MD → M'D', the duality constraints on the amplitude signs in MB → M'D' are investigated. It is shown that the amplitude signs determined by duality are consistent with those predicted by the extended version of $SU(6)_W$ symmetry with the universal dominance of the $\Delta L_z = 0$ or $\Delta L_z = \pm 1$ amplitude in the mesonic transitions of the baryons. (auth)

27994 QUARK MODEL AND STRANGE PARTICLE INTERACTIONS AT HIGH ENERGIES. Besliu, C. (Univ. of Bucharest); Mihul, A.; Nicorovici, N. Rev. Roum. Phys.; 18: No. 9, 1139-1148(1973).

The model proposed by Satz is extended in such a manner to become able to predict branching rules between the partial cross sections of the strange particle interactions at high energies. (auth)

27995 RIGOROUS TEST OF THE FORWARD-DISPERSION RELATION AND DETERMINATION OF πN LOW-ENERGY PARAMETERS. Pham, T.N.; Truong, T.N. (Centre de Physique Théorique, de l'Ecole Polytechnique, 17, rue Descartes, 75230 Paris Cedex 05, France). Phys. Rev. D 8: No. 11, 3980-3993 (1 Dec 1973).

General and rigorous methods for testing ordinary and average πN forward-dispersion relations using experimental data at finite energy are given. Using the total cross-section data up to 60 GeV, it is found that the energy variation of the real part of the symmetric forward amplitude is compatible with experimental data in the 8-20-GeV region. The magnitude of the real part in this energy range cannot be strictly tested without total cross-section data from the National Accelerator Laboratory. An average upper bound for the sum of π^+p and π^-p total cross sections in the range of 60-500 GeV is given, which can be used as a rigorous test of the dispersion relation. General and rigorous methods are also given for the determination of low-energy parameters. It is shown that the πN coupling constant can be determined in principle to better than 1%. Low-energy data with great precision are required from pion factories for an accurate determination of all πN low-energy parameters. (auth)

27996 EXTRAPOLATION OF THE π-N AMPLITUDE TO THE π-π CUT. Chao, Y.A.; Zia, R.K.P. (Theory Division, Rutherford High Energy Laboratory, Chilton, Didcot, Berkshire, England). Phys. Rev. D 8: No. 11, 4085-4092 (1 Dec 1973).

The problem of extrapolating, at a fixed energy, a scattering amplitude determined from phase-shift analysis onto the t- or u-channel cuts is studied in detail by following Cutkosky's work on reproducing kernels. The Riesz representation theorem is used to estimate and minimize the bounds on extrapolation errors. Percentage errors of extrapolating the present six-partial-wave π-N amplitude to various points beyond the two-pion cut are calculated explicitly. These errors arise from extrapolation only and are independent of the empirical values of the phase-shifts. (auth)

27997 FUNDAMENTAL POLE PARAMETERS OF THE N(1470). Lee, P.S. (Physics Department, University of California, Irvine, California, 92664); Shaw, G.L. Phys. Rev. Lett. 31: No. 16, 1029-1031 (15 Oct 1973).

We have recently shown that the position and residue of the S-matrix pole of the Δ (1236) are unique, independent of the particular resonance formula used, thus resolving a discrepancy among phenomenological fits. Unlike the P_{33} partial wave, the P_{11} resonance is highly inelastic, very broad, and has a large background. This produces huge uncertainties in its mass and width, depending on the parametrization used. We report here that the position of the N(1470) pole is uniquely determined, 1380-110i MeV, from fits to the CERN phase shifts. (auth)

27998 PARTIAL-WAVE ANALYSIS OF THE DECK AMPLITUDE FOR $\pi N \to \pi\pi\pi N$. Ascoli, G.; Jones, L.M.; Weinstein, B.; Wyld, H.W. Jr. (Physics Department, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). Phys. Rev. D 8: No. 11, 3894-3919 (1 Dec 1973).

We present a straightforward method for calculating the amplitudes of the various JMLS states in the final 3π system of the reaction $\pi N \to \pi\pi\pi N$, assuming a Deck-model form for the production process. This calculation allows us to study relative phases of different partial waves, and the nucleon spin structure of the production amplitudes, in an unambiguous fashion. We find that the magnitudes and phases of 3π partial waves obtained by this method agree reasonably well with those obtained by applying an experimental fitting program to Monte Carlo events generated using the Deck formula; this may be interpreted as a check on the assumptions of the fitting program. Likewise, the magnitudes and phases agree reasonably well with those obtained from the data, confirming the belief that the A_1 and A_3 effects are probably produced by the Deck mechanism. In the rest system of the three pions, only one nucleon helicity-amplitude combination is dominant. The method of analysis can be applied to similar models for other production reactions. (auth)

27999 S-WAVE PION-NUCLEON SCATTERING. Hackman, R.H. (University of Maryland, College Park, Maryland 20742). Phys. Rev. D 8: No. 11, 3920-3930 (1 Dec 1973).

Integral equations for the off-mass-shell S-wave pion-nucleon scattering amplitudes are developed from the Low equation. The seagull terms, present in this formulation, are calculated using partially conserved axial-vector current and current algebra, with the assumption that the pion current is independent of second- and higher-order derivatives of the pion field. These terms provide the potential for the S-wave equations, as expected, but also modify the rescattering integral. With a cutoff assumption, we obtain numerical solutions valid for low energy. Agreement with experiment is surprisingly good. (auth)

28000 STATISTICAL MECHANICS FOR VELOCITY DEPENDENT INTERACTIONS. Srinivas, M. D. (Univ. of Rochester, NY); Prahalad, Y. S. J. Math. Phys. (N.Y.); 15: No. 1, 67-69 (Jan 1974).

The quantum corrections to the phase space distribution function are obtained for general velocity dependent interactions. It is noted that a study of the thermodynamic properties of bulk nuclear matter may settle the question of velocity dependence of nucleon-nucleon interaction. (auth)

28001 NUCLEAR MASS DISTRIBUTION FROM ISOTOPIC STRUCTURE OF THE GIANT RESONANCE. Leonardi, R. (Inst. of Physics, Bologna). Kakuriken Kenkyu Hokoku; 5: 443-449 (1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendei, Japan (12 Sep 1972). See CONF-720907-.

It is pointed out that photo-cross-section measurements combined with the existence of the fairly good isospin SU(2) symmetry in nuclei may be usefully utilized to determine the neutron radii. Lead-208 is considered. (JFP)

28002 PARITY DOUBLETS AND THE MANDELSTAM-SOMMERFELD-WATSON TRANSFORMATION IN BACKWARD K^+p ELASTIC SCATTERING. Sacharidis, E. J. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Phys.; B69: No. 1, 157-184 (1974).

K^+p backward elastic scattering and polarization are described

in terms of u-channel exchanges. In the Reggeization of the scattering amplitudes, use is made of the Mandelstam–Sommerfeld-Watson transformation and rotation functions of the second kind. The residues are assumed for convenience to depend meromorphically on u rather than on $\sqrt{u}$. A description is obtained in terms of only two adjustable parameters of all existing measurements on elastic K^+p scattering and polarization for incident laboratory momenta above 1.5 GeV/c and center-of-mass scattering angles larger than 120° ($\cos\theta < -0.50$). (auth)

28003 DUALITY DIAGRAMS AND REGGE CUTS IN MESON–BARYON SCATTERING: DESCRIPTION OF πN AND KN SCATTERING. Girardi, G.; Lacaze, R.; Peschanski, R. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys.; B69: No. 1, 107-141(1974).

A reggeized absorption model including lower-lying Regge cuts and satisfying duality requirements is proposed. It is shown that the introduction of these singularities, especially the reggeon-pomeron-reggeon (RPR) cuts, provides a solution to many puzzles in meson-baryon scattering. Theoretical evidences for the cuts, using duality diagrams and s-channel unitarity are given. These theoretical constraints reduce strongly the flexibility of the model and give it a good predictive power. With only twelve parameters, one obtains an excellent description of observables in π-nucleon and K-nucleon forward scattering in a large energy range ($5 \leq P_{lab} \leq 30$ GeV/c). This success provides a better understanding of Regge cuts in a duality framework. (auth)

28004 NEW DISPERSION RELATION FOR KAON–NUCLEON SCATTERING. II. K-Matrix Parametrization of the Low-Energy Region. Conti, A. (Univ., Lecce, Italy). Nucl. Phys.; B70: No. 1, 116-124(1974).

A modified forward dispersion relation is proposed for KN scattering, which is more suitable than the conjugate Hilbert transform. Using the K-matrix parametrizations of the low energy K^-p data a fairly good consistency for the K^+p process is found, and one set of signs of the K^-p real part is slightly favored in the intermediate energy region. (auth)

28005 CAN AND DOES THE POMERON OCCUR MORE THAN ONCE IN A SINGLE PROCESS? Shankar, R. (Univ. of California, Berkeley). Nucl. Phys.; B70: No. 1, 168-188(1974).

A study of high energy diffractive amplitudes (the elastic amplitude being a special case), has revealed the following regularities at small momentum transfers: they all tend to be almost purely imaginary, and they all have the same energy dependence, leading to universal, constant (modulo logarithms) cross sections at high energies. It is assumed that these regularities are produced by an underlying, common mechanism, which is defined as the pomeron. The question then addressed is whether the pomeron, so defined, can and does occur more than once in a single process. It is demonstrated that various models for the pomeron (involving Regge poles, Regge cuts, geometric ideas like diffraction, etc.) lead to different answers to this question, none of them quantitative. By contrast, the introduction of the pion–pole dominance (PPD) hypothesis is shown to lead to a model-independent quantitative answer. Assuming just the above definition of the pomeron, the PPD hypothesis predicts certain processes that must be termed multi-pomeron by the advocates of all models, and provides estimates for their cross sections. The predictions of this hypothesis are compared with experiment. It is shown that PPD leads to, and sets lower bounds for, inclusive triple-pomeron cross sections assuming no more than our general definition of the pomeron. It is pointed out that the repetition of the pomeron, guaranteed by PPD, may be used to set upper bounds on asymptotic total cross sections. The crucial property of the result, that total cross sections must eventually die away, is that it does not rely on any model-dependent property of the pomeron, such as factorization. (auth)

28006 PARTIAL-WAVE ANALYSIS OF THE $\pi^+\pi^+\pi^-$ SYSTEM THROUGH THE REGION OF THE A_2 MESON. Thompson, G.; Badewitz, R. C.; Gaidos, J. A.; McIlwain, R. L.; Paler, K.; Willmann, R. B. (Purdue Univ., Lafayette, IN). Nucl. Phys.; B69: No. 2, 381-398(1974).

A recent spin-parity analysis of the $\pi^+\pi^+\pi^-$ system formed opposite a proton and a coherent deuteron by incident 13 GeV/c^2 π^+ mesons, is extended to a three-pion mass of 1.9 GeV/c. Relative proportions of the contributing partial waves are presented, from threshold, and the A_2 region is discussed in detail. Contrary to results with the $(3\pi)^-$ system, a change in phase is noted for the 2^- amplitude decaying to $f^0\pi^+$ via an S-wave. The method employs the University of Illinois three-body partial-wave-analysis program. (auth)

28007 HIGH-MASS DIFFRACTION AND REGGE BEHAVIOR OF TOTAL CROSS SECTIONS. Kronenfeld, R. (Stanford Univ., CA). Nucl. Phys.; B69: No. 2, 431-444(1974).

A modified two-component model of particle production in which diffractive excitation into high mass states gives a contribution to K^+p, π^+p and pp total cross sections of sufficient magnitude and with the proper associated threshold to be a possible explanation of deviations of σ_{tot} from Regge pole model fits at Serpukhov energies is considered. Tests of the model for K^+p scattering are presented by extrapolating σ_{tot} to National Accelerator Laboratory energies and by calculating the high mass diffraction contribution to the forward peak in inclusive reactions. The consistency of this scheme is discussed in relation to the pomeron intercept and the form of the triple-pomeron coupling. (auth)

28008 $N_\gamma\ 3/2^-$ (1520) RESONANCE IN $\pi N \to \pi\Delta$. York, M. J. (Univ. of Birmingham, Eng.). J. Phys., A (London); 7: No. 1, 35-39(1 Jan 1974).

Theoretical and experimental evidence for a large d-wave $\pi\Delta$ decay for the $N_\gamma\ 3/2^-$ (1520) resonance is presented although the s-wave decay is kinematically preferred by a factor of about 19. The theoretical method here is a simple low energy bootstrap model, with resonance saturated dispersion relations (consistent with the Harari-Freund hypothesis). It agrees well with the dip structure required by ρ-baryon duality and also with experiment. (auth)

28009 NEW PREDICTIONS OF THE VECTOR-MESON DOMINANCE MODEL FOR THE REACTIONS $\pi N \to \rho^0 N$ AND $\gamma N \to \pi N$. Achasov, N. N.; Shestakov, G. N. (Inst. of Mathematics, Novosibirsk, USSR). Nucl. Phys.; B68: No. 2, 452-460(1974).

It is shown that the assumption of pole vector-meson dominance for the Ball invariant amplitude having a π-meson pole is sufficient for reproducing the longitudinal amplitude of ρ^0-production by the photoproduction amplitude at $|t| < 0.1$ (GeV/c)^2. The strong k^2-dependence of the Ball invariant amplitude without the π-meson pole was found by the deviations of theoretical predictions obtained in the VDM framework for the longitudinal ρ^0-production amplitude from the experimental data in the region $|t| > 0.1$ (GeV/c)^2. A natural explanation of the k^2-dependence in the one-pion exchange model with absorption is given. The problem of A_2-exchange is discussed. (auth)

28010 TWO NEW CONSERVATION LAWS IN STRONG INTERACTIONS. Vaklev, I. S.; Drenska, S. B.; Ivanov, M. I.; Nikolov, A. V. (Inst. of Nuclear Research, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 11, 1433-1435(1973). (In Russian).

Strong interactions are classified into two classes: interaction of intermediate forces between baryons and K-mesons and superstrong interactions between baryons and π mesons. These reactions are designated by simple K processes. New conservation laws are formulated for these processes. (JSR)

28011 POSSIBILITY OF MEASURING THE ISOSPIN OF OMEGA-HYPERON. Nikitin, Yu. P.; Satsunkevich, I. S. (Inst. of Physics, Minsk). Yadern. Fiz.; 19: No. 2, 431-433(Feb 1974). (In Russian).

Investigation of the Ω^- isospin features can be used as some (but not definite) test of the possibility to identify this particle with the members of the baryon $3/2^+$ decuplet. The search for the isotopic triplet of quasistable baryons with the strangeness $S = -3$ (Ω^- hyperon could be a member of such triplet) along with the appropriate analysis of the relative probabilities of the $\Xi\pi$ channel of Ω^- decay, will be the simplest experimental tool for determination of the Ω^--hyperon isospin. (auth)

28012 ISOTOPIC AMPLITUDES OF THE REACTIONS $\pi N \to \pi\pi N$ NEAR THRESHOLD UP TO THE THIRD ORDER TERMS. Volkovitskii, P. E.; Gulkanyan, G. R. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 2, 417-423(Feb 1974). (In Russian).

The isotopic invariant amplitudes of various channels of the reactions $\pi N \to \pi\pi N$ are obtained up to the terms of the third order in the relative momenta of the final particles. The formula are given for the simultaneous analyses of the data on different $\pi N \to \pi\pi N$ channels. (auth)

28013 ANALYSIS OF πN SCATTERING AT HIGH ENERGIES BY MEANS OF DISPERSION RELATIONS. Solov'ev, L. D.; Shchelkachev, A. V. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 19: No. 2, 409-416(Feb 1974). (In Russian).

Various possibilities are studied to achieve an agreement between the last Serpukhov measurements of the total cross sections of the $\pi^\pm p$ scattering, the differential cross section of the forward charge exchange scattering $\pi^- p \to \pi^0 n$, and the dispersion relations. (auth)

28014 DETERMINATION OF SLOPE OF THE PION TRAJECTORY IN THE REACTION $\pi N \to \rho N$ IN FRAMEWORK OF THE OPTICAL MODEL. Guzhavin, V. M.; Dubovikov, M. S.; Lebedev,

A. V.; Nilov, A. F. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 19: No. 2, 401-408(Feb 1974). (In Russian).

Slope of the pion trajectory is determined in framework of the optical model for the first time. Experimental data on the reactions $\pi^- p \to \rho^0 n$ and $\pi^- p \to \rho^- p$ in the momentum range 4 to 15 GeV/c were used. The value of α'_π was found to be 0.4 ± 0.1 (GeV/c)$^{-2}$. (auth)

28015 CONSISTENT DESCRIPTION OF DIFFERENCE OF THE TOTAL $\pi^{-+}p$ SCATTERING CROSS SECTIONS AND THE CHARGE EXCHANGE CROSS SECTION. Zotov, N. P.; Starkov, N. I.; Tsarev, V. A. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 19: No. 2, 366-369(Feb 1974). (In Russian).

Possibility is discussed to describe in a unified way the difference of the total $\pi^+ p$ scattering cross sections and the differential cross section of the π^0-meson forward charge exchange scattering by means of a modified Regge-pole model. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 28171 and 28363.

28016 IMPACT PARAMETER STUDY OF HIGH ENERGY ELASTIC SCATTERING. Henyey, F. S.; Tuan, R. H.; Kane, G. L. (Univ. of Michigan, Ann Arbor). Nucl. Phys.; B70: No. 3, 445-460(1974).

The imaginary part of the proton-proton elastic scattering amplitude, as measured at the ISR, is examined in impact parameter. The transformed amplitude has two important properties. First, it is very accurately Gaussian in the impact parameter from the center to two fm with very little flattening near the center. Flattening would be expected from eikonalization. Secondly, there is a tail beyond two fm with a much flatter slope. This tail in impact parameter is equivalent to the break of $d\sigma/dt$ at $t \approx -0.15$ GeV. The physical origin of the tail is discussed. It cannot reasonably be diffraction dissociation, since diffraction should be large where absorption is large. It is suggested that the tail is due to dissociation which must be distinguished from its diffractive part, and make a physical model which gives the tail and describes $d\sigma/dt$ very well. This model predicts the Deck model part of the diffraction inelastic cross section. The interpretation of elastic scattering is discussed in terms of s-channel unitarity rather than a t-channel exchange or the structure of a single hadron. (auth)

28017 DENSITY CORRELATIONS OF HADRON GAS AND THE ORIGIN OF EARLY MULTIPLICITY SCALING. Weingarten, D. (Univ. of Copenhagen). Nucl. Phys.; B70: No. 3, 501-533(1974).

A sequence of functions called density correlations is defined, which measure statistical correlations between momentum space densities of particles in the ensemble of inelastic final states produced by scattering a pair of hadrons. Then it is shown that early multiplicity scaling of the distribution of charged particles produced by pp collisions can primarily be explained by the assumption that fluctuations of the density of charged particles are quite random and therefore higher correlation functions are small in an appropriate sense, combined with the assumption that the first three density correlations fulfill an approximate form of Feynman scaling at small values of x. These assumptions are also used to derive an expression for the scaling function $\Psi(\eta)$ which is completely determined by $\langle N^2 \rangle_y / \langle N \rangle_y^2$ and $\langle N_y^2 \rangle_y / \langle N \rangle_y^2$, and a recursion relation to calculate $\langle N^m \rangle_y / \langle N \rangle_y^m$, $m \geq 4$, from $\langle N_y^2 \rangle_y / \langle N \rangle_y^2$ and $\langle N^2 \rangle_y / \langle N \rangle_y^2$. The prediction for $\Psi(\eta)$ accurately reproduces data in the intervals $0.2 \leq \eta \leq 3.1$, 50 GeV/c $\leq p_L \leq$ 303 GeV/c, and the predictions for $\langle N^m \rangle_y / \langle N \rangle_y^m$, $4 \leq m \leq 10$, agree with observed values in the interval 50 GeV/c $\leq p_L \leq$ 303 GeV/c. (auth)

28018 HIGH ENERGY pp DATA AND THE REGGEON THEORY OF DIFFRACTION SCATTERING. Sukhatme, U. P.; Ng, J. N. (Univ. of Washington, Seattle). Nucl. Phys.; B70: No. 2, 229-236 (1974).

Recent proton-proton scattering experiments from the CERN ISR show several striking features. There is strong evidence that the total cross section is rising. The elastic differential cross section shows a break in the forward slope, as well as a pronounced dip-bump structure, with the dip located at $t \approx -1.3$ (GeV/c)^2. It is demonstrated that all these features and their energy dependence can be simultaneously and quantitatively very well described within the framework of Gribov reggeon calculus. (auth)

28019 ELASTIC PION–DEUTERON SCATTERING NEAR THE 3-3 RESONANCE. Gabathuler, K. (SIN, Villien, Ger.); Wilkin, C. Nucl. Phys.; B70: No. 2, 215-228(1974).

Elastic pion-deuteron scattering at medium energies is analyzed on the basis of the Brueckner model, particular attention being paid to the kinematic approximations that have to be made. In contrast to an earlier Glauber-type calculation, the energy dependence of the large angle cross section is reasonably well reproduced. (auth)

28020 DIRECT INTERACTION OF HIGH-ENERGY PARTICLES WITH NUCLEI. I. pp 9-33 of Yadernye Reaktsii pri Vysokikh Ehnergiyakh. Denisov, F. B.; Makhedov, V. N. (eds.). Moscow; Atomizdat (1972). (In Russian).

The collision of high energy particles with nuclei is examined on the basis of the Serber-Goldberg model. The method of impulse approximation with two-dimensional waves for the calculation of the cross sections is examined. Experimental results on the measurement of the energy spectra of the scattered protons at $E_p = 600$ MeV are reported. A comparison is made of the calculated and experimental results. (tr-auth)

28021 PERTURBATIVE TREATMENT OF THRESHOLD CONTRIBUTIONS TO A RISING PP TOTAL CROSS SECTION. Gaisser, T.K. (Bartol Research Foundation of The Franklin Institute, Swarthmore, Pennsylvania 19081); Tan, C. Phys. Rev. D 8: No. 11, 3881-3887 (1 Dec 1973).

We analyze the relation between increasing $N\bar{N}$ production and increasing σ_{tot} in a two-component picture. The possible increasing contribution to the cross section of diffractive dissociation into high-mass states is taken into account. We conclude that it is likely that both effects are important at the CERN ISR energies. We also find that the short-range correlation part of the inelastic cross section without $N\bar{N}$ production must decrease above $s \sim 150$ GeV^2. The decrease is consistent with the form $\sigma^{(0)} \propto s^{\alpha_0 - 1}$ with $\alpha_0 = 0.92 \pm 0.04$. (auth)

28022 LEFT-RIGHT MULTIPLICITIES AND THE TWO-COMPONENT MODEL. Snider, D.R. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 8: No. 11, 4206-4208 (1 Dec 1973).

Left-right multiplicities provide a more sensitive measure to the relative amount of diffractive dissociation in the total cross section than total multiplicity distributions. New 200-GeV/c left-right cross sections are found to be in qualitative agreement with the two-component model of Frazer, Peccei, Pinsky, and Tan. (auth)

28023 DEUTERON SPIN ALIGNMENT IN HIGH-ENERGY ELASTIC PROTON–DEUTERON BACKSCATTERING. Vasan, S.S. (Department of Physics, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). Phys. Rev. D 8: No. 11, 4092-4097 (1 Dec 1973).

The spin alignment $\langle T_{20} \rangle$ of recoil deuterons in high-energy p-d elastic scattering at 180 ° is calculated in two models. One is the simple nucleon–transfer or pickup mechanism. The other is the extended pickup mechanism of Kerman and Kisslinger that includes, in addition to nucleon exchange, the exchange of N* (1688) resonance which is taken to be present in the deuteron with a small (1–2 %) probability. For proton lab energies around 1 GeV, the Kerman–Kisslinger model gives alignments that are characteristically different from the predictions of the simple exchange model, showing that the presence of the N* in the deuteron has a significant effect at these energies. (auth)

28024 SYMMETRY CONSIDERATIONS FOR PARITY-VIOLATING EFFECTS IN THE $n + p \to d + \gamma$ REACTION. Herczeg, P.; Wolfenstein, L. (Department of Physics, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). Phys. Rev. D 8: No. 11, 4051-4054 (1 Dec 1973).

The γ-ray asymmetry α for polarized neutrons and circular polarization P_γ for unpolarized neutrons for the thermal capture reaction $n + p \to d + \gamma$ are discussed using charge symmetry. For each of a set of meson-exchange diagrams considered, with a given isospin component of the weak Hamiltonian, there is a contribution to at most one of these two observables. If the D state of the deuteron is not included, there are no significant meson-exchange contributions to α. (auth)

28025 MESON PRODUCTION AT LARGE TRANSVERSE MOMENTUM. Landshoff, P.V.; Polkinghorne, J.C. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge, England). Phys. Rev. D 8: No. 11, 4157-4166 (1 Dec 1973).

An earlier, rather general discussion of inclusive reactions at large transverse momentum made quantitative by the inclusion of extra, dynamical assumptions. The model investigated is one in which the predominant production at large transverse momentum is of mesons of the pseudoscalar octet. It is predicted that equal numbers of π^+ and K^+ are produced, and that at 90° the production of positively charged particles exceeds that of negatively charged particles by about 50%. At rather smaller angles, the + to − charge ratio rises to about 4 at the upper end of the range of allowed values of transverse momentum. When a large-transverse-momentum particle is produced, there is a small increase in the number of particles moving in transverse directions with small transverse momentum, at the expanse of the longitudinal multiplicity. (auth)

28026 ENERGY SUM RULE AND THE APPROACH TO SCALING: AN INCLUSIVE AND EXCLUSIVE VIEW. Sivers, D. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. D 8: No. 11, 4004-4014 (1 Dec 1973).

The approach to Feynman-Yang scaling of single-particle inclusive spectra is discussed in terms of the average fraction of c.m. energy per event carried off by each type of constituent. Experimental values for energy fractions in pp collisions are presented and compared with the results of a Mueller-Regge expansion for the invariant cross sections in the fragmentation region. By examining the behavior of energy fractions in an independent-emission model, it is shown that known dynamic properties of the exclusive components of an inclusive process provide a natural scale by which the energy fractions approach their asymptotic values. The existence of such a scale is shown to explain the rapid approach to asymptotic behavior of the inclusive $pp \rightarrow \pi$ spectra while the $pp \rightarrow \bar{p}$ spectrum rises to an order of magnitude between Brookhaven Alternating Gradient Synchroton and CERN Intersecting Storage Rings energies. (auth)

28027 METHOD OF THE STRAIGHT-LINE PATHS AND THE EIKONAL PROBLEM. Kuleshov, S. P.; Matveev, V. A.; Sisakyan, A. N.; Smondyrev, M. A.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 18: No. 2, 147-160(Feb 1974). (In Russian).

Structure of the "noneikonal" contributions into the two-nucleon scattering amplitude, described by the sum of the ladder type graphs in a scalar model, is investigated. (auth)

28028 PION-DEUTERON AND PION-NUCLEON SCATTERING LENGTHS. Kolybasov, V. M.; Kudryavtsev, A. E. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 8, 310-311(20 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 8, 527-529(20 Oct 1973).

A number of items in the calculation of the deuteron scattering length are refined. These include a more accurate calculation of the contribution of scatterings with multiplicity larger than tw, allowance for the energy released in the charge exchange process $\pi^- + p \rightarrow \pi^0 + n$, and a calculation with a more realistic deuteron function, the third Moravisck function. (JFP)

28029 DIFFRACTIVE PARTICLE PRODUCTION AND ANISOTROPIC FIREBALL DECAY. Ranft, G.; Ranft, J. (Karl-Marx-Univ., Leipzig). Nucl. Phys.; B69: No. 2, 285-297(1974).

A model is considered for the diffractive component of particle production with anisotropically decaying fireballs. Application of this model to recent data on diffractive proton production gives favorable results. For these data the fragmentation model with isotropically decaying fireballs cannot account. The behavior of inclusive single particle, two-particle and multiplicity distributions are studied. (auth)

28030 THEORETICAL CONSIDERATIONS ON THE EXTRACTION OF pp CROSS SECTIONS FROM COSMIC RAY ABSORPTION DATA. Camillo, P.; Fishbane, P. M.; Trefil, J. S. (Univ. of Virginia, Charlottesville). Nucl. Phys.; B69: No. 2, 426-430 (1974).

It was suggested, based on the application of Glauber theory to proton-air collisions, that a proton-proton total cross section which rises with energy as $\ln^2 s$ is consistent with cosmic ray data. It is shown that if instead of a constant width, one uses a pp diffractive width which decreases consistent with present data, the cosmic ray data continue to rule out constant σ^T_{pp}. However, the size of the derived pp cross section is somewhat sensitive to the width, and in the relevant energy range 15% uncertainty in σ^T_{pp} is the maximum consequence of uncertainties in the width. Repetition of these experiments on different nuclei is not a particularly useful way to resolve these width-dependent effects. (auth)

28031 SATURATION OF THE FROISSART BOUND. Pakvasa, S.; Sugawara, H. (Univ. of Hawaii, Honolulu). Phys. Lett.; 48B: No. 4, 333-337(18 Feb 1974).

It is shown that the leading J-plane singularity in the crossed channel must be one of three precise possibilities if the Froissart bound is saturated. These are delineated. The Auberson-Kinoshita-Martin integral representation is applied to the p-p differential cross section at high energies. The results seem to support saturation of Froissart bound. (auth)

28032 UNITARY MODEL OF PIONIZATION. Redei, L. B. (Umea Univ., Sweden). Phys. Lett.; 48B: No. 4, 349-353(18 Feb 1974).

A unitarity, isospin invariant model is presented for multiple pion production in proton-proton scattering which is in good agreement with the experimental data. (auth)

28033 NUCLEON-NUCLEON POTENTIAL THAT INCLUDES THE EFFECT OF THE N*(1236). Haapakoski, P. (Nordita, Copenhagen). Phys. Lett.; 48B: No. 4, 307-310(18 Feb 1974).

The transition potentials for the reaction $N + N \rightleftharpoons N + N^*$ (1236) and $N + N \rightleftharpoons N^*$ (1236) + N^* (1236) are derived in the case of the π and ρ exchange using the quark model. The nucleon-nucleon scattering in the $T = 1$, $^1S_0$ state is treated as a coupled channel $N + N \rightleftharpoons N + N^*$ system. (auth)

28034 ELECTROMAGNETIC EFFECTS IN POLARIZATION FOR SCATTERING OF NEUTRONS AND Λ^0 HYPERONS ON PROTONS. Kopelivich, B. Z.; Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 2, 340-349 (Feb 1974). (In Russian).

As a result of interaction of the neutron magnetic moment with the proton charge the neutron gets an essential polarization in small-angle scattering, while it is small in case of proton. This effect is to be taken into account in phase-shift analysis and in test of the isotope invariance. Studying the effect, one is able to obtain additional information on the hadronic part of the scattering amplitude and in case of neutral hyperons it makes it possible to measure their magnetic moments. Electromagnetic effects for the tensors D_{ik}, K_{ik}, and C_{ik} are also considered. (auth)

28035 EFFECTS OF THE FRESNEL DIFFRACTION AT SCATTERING OF HIGH-ENERGY PARTICLES ON ATOMIC NUCLEI. Koval, L. N.; Matinyan, S. G. Yadern. Fiz.; 19: No. 2, 380-388(Feb 1974). (In Russian).

Effect of the Fresnel diffraction at rescattering of particles on nucleons inside a nucleus is considered. The elastic scattering amplitude and corrections to the total cross sections due to these effects are obtained. (auth)

28036 ANALYSIS OF THE FORWARD np AND $\bar{p}p$ CHARGE EXCHANGE AMPLITUDES AT INTERMEDIATE AND HIGH ENERGIES. Diu, B. (Laboratoire de Physique Theorique et des Hautes Energies, Paris). Nuovo Cim.; 20A: No. 1, 115-133 (1 Mar 1974).

The np and $\bar{p}p$ charge exchange processes are analyzed in the very forward region ($|t| \leq 2m_\pi^2$), independently of any particular model, within the general hypothesis that only the t-channel π exchange term can vary appreciably in such a small t-interval. This hypothesis is shown to be quite restrictive; it implies in particular that the fall-off of the differential cross section between $t = 0$ and $|t| \simeq m_\pi^2$ cannot exceed a factor 2, whatever the energy (provided it is not too near to threshold). Now such a factor 2 seems to be actually found experimentally, in np charge exchange, for all incident momenta between 600 MeV/c and 24 GeV/c; it then turns out that the 3 linear combinations of the 5 invariant amplitudes which can contribute at $t = 0$ (besides t-channel π exchange) are practically determined in the corresponding range of values of s. These approximate relations between the amplitudes are discussed and compared with the predictions of some specific models. Finally, they are analyzed using fixed-t dispersion relations; the approximate values obtained for the amplitudes in the $np \rightarrow pn$ channel give nontrivial restrictions on the absorptive parts in the crossed $\bar{p}p \rightarrow \bar{n}n$ channel. (auth)

28037 HIGH ENERGY ESTIMATION FROM ANGULAR DISTRIBUTIONS AND RELATED PROBLEMS. Aly, H. H. (Southern Illinois Univ., Edwardsville); Sanders, S. G.; Bussian, A. E. Nuovo Cim.; 20A: No. 1, 85-92(1 Mar 1974).

The angular distribution of the secondary particles is used to estimate the primary-particle energy to construct both differential and integral energy spectra. These spectra are compared to the spectra obtained from experimental measurement of high energy nucleon-nucleon interactions resulting in a liquid-hydrogen target and detected by spark-chambers-ionization-calorimeter set-up. (auth)

28038 QUASI-INFINITE-MOMENTUM LIMIT, SUM RULES FOR NONFORWARD AMPLITUDES AND LIGHT-CONE COMMUTATORS. Mazzanti, P.; Salvini, M. (Univ., Bologna). Nuovo Cim.; 20A: No. 1, 93-106(1 Mar 1974).

Finite-energy sum rules for the imaginary part of a current-proton nonforward scattering amplitude are obtained. The sum rules relate structure functions to form factors of bilocal operators appearing in the Gell-Mann-Fritzsch light-cone algebra. The equal-time limit is considered in some cases. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 28565 and 28583.

28039 GEOMETRY OF THE OCTET. Michel, L. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France); Radicati, L. A. Ann. Inst. Henri Poincare, Sect. A; 18: No. 3, 185-214(1973).

A number of formulas equivalent to those already known are demonstrated. The demonstrations presented are simpler than those explicitly using the coordinates and enable an easier extension to be made to more complicated cases. SU(n) algebras which are symmetric and antisymmetric and invariant on $R(n^2-1)$ and the geometry of the SU(3) octet are examined successively. (auth)

28040 DUAL MODELS AND SPONTANEOUS SYMMETERY BREAKING. II. Bardakci, K. (Univ. of California, Berkeley). Nucl. Phys.; B70: No. 3, 397-413(1974).

The stability of the vacuum of the orbital dual model with zero intercept with respect to spurion emission is investigated. Although the model is not fully satisfactory because of the presence of negative norm states, it serves as a simplified laboratory for the more realistic (and more complicated) models. Feynman rules for the calculation of the effective potential are developed, and the problem of finding the Goldstone minimum is reduced to a non-linear integral equation. The propagator of the model is also determined, and trajectories are shown to remain linear. (auth)

28041 SU(3) FOR CONSTITUENT AND CURRENT QUARKS: HOW DIFFERENT ARE THEY?. Fuchs, N.H. (Department of Physics, Purdue University, West Lafayette, Indiana). Phys. Rev. D 8: No. 11, 4079-4085 (1 Dec 1973).

Algebraic properties of the transformation between constituent- and current-quark bases are discussed in the case when SU(3) is broken for the current quarks. In a simple model, it is shown that $SU(4)_W$ may still be an exact symmetry in the constituent-quark basis. Still within the context of the model, the question of whether the transformation actually does distinguish two SU(3) algebras in nature, one for current and one for constituent quarks, is investigated. It is shown that the so-called σ terms of meson-baryon scattering provide a means of determining if there is such a distinction. (auth)

28042 TESTS OF THE THREE-TRIPLET MODELS IN THE DEEP-INELASTIC REGION. Koca, M. (International Centre for Theoretical Physics, Trieste, Italy); Razmi, M.S.K. Phys. Rev. D 8: No. 11, 4142-4151 (1 Dec 1973).

Light-cone algebra is written for the currents transforming like (1,8), (8,1), and (8,8) representations of SU(3) " $\otimes$/SU(3)', and is used to obtain the predictions of the Han-Nambu model and the Cabibbo-Maiani-Preparata model for the Bjorken form factors. Comparison is made with the usual light-cone current-algebra results. (auth)

28043 UNITARY REPRESENTATIONS OF SO(n,1). Wong, M. K. F. (Fairfield Univ., CT). J. Math. Phys. (N.Y.); 15: No. 1, 25-30(Jan 1974).

All unitary representations of SO(n,1) were obtained in the group chain $SO(n,1) \supset SO(n-1) \supset \ldots \supset SO(2)$. The branching laws were explicitly formulated. These results follow from the observation that the matrix elements of the "noncompact" generators of SO(n,1) differ from the corresponding matrix elements of the same generators of SO(n + 1) by a factor of $\sqrt{-1}$. The branching laws then follow from the unitarity condition. It is also observed that the invariants of SO(n,1) have the same eigenvalues as the invariants of SO(n + 1). Finally it is shown that the normalized raising and lowering operators in SO(n + 1), obtained by Pang and Hecht in graphs, and by Wong in algebraic form, can be similarly defined and applied to SO(n,1). (auth)

28044 BOSON REPRESENTATION OF ANGULAR MOMENTUM. II. Mikhailov, V. V. (Physical-Technical Inst., Kazan). Teor. Mat. Fiz.; 18: No. 3, 342-352(Mar 1974). (In Russian).

The states of the system of N harmonic oscillators with the fixed complete number of quanta are reduced to the irreducible representations of the group SU(2). In this decomposition the base which was introduced earlier is proved to be one with the greatest dimensionality. The operators and the discrete base of the representation of noncompact group SU(1,1) are constructed in the case of three harmonic oscillators. The Bargmann representation for the states constructed is discussed. (auth)

28045 CALCULATION OF THE CLEBSCH-GORDAN COEFFICIENTS AND THEIR PHYSICAL APPLICATION. Shelepin, L. A. Tr. Fiz. Inst., Akad. Nauk SSSR; 70: 3-119(1973). (In Russian).

Questions on the theory of Clebsch-Gordan coefficients are discussed from the viewpoint of their physical application. The apparatus of the generalized theory of angular momentum including both the Regge symmetry and higher symmetries is constructed. The relation of the theory of angular momentum with the topological properties of multidimensional spaces is examined. Calculation techniques are developed for the Clebsch-Gordan coefficients of the Lee compact group, preferentially the SU_n group, closely connected with the generalized theory of angular momentum. On the basis of the theory of Clebsch-Gordan coefficients a method is proposed for the calculation of the relativistic cross section. A method of group analysis of complex physical systems (atoms, nuclei, molecules, elementary particles, and radiation) is also developed. A series of practical results is obtained. Special attention is given to the aspects of universality of the Clebsch-Gordan coefficients and to the investigation of their interaction with various areas of mathematics and physics. (tr-auth)

28046 THEORETICAL GROUP ANALYSIS OF COMPLEX PHYSICAL SYSTEMS. Karasev, V. P. Tr. Fiz. Inst., Akad. Nauk SSSR; 70: 147-220(1973). (In Russian).

A group of problems connected with the theoretical group analysis of complex physical systems is solved. The Clebsch-Gordan expansion of the SU_n group is analyzed. Calculation methods and graphic techniques for the Clebsch-Gordan coefficients of the SU_n groups are developed. On the basis of the close relation of the linear group with the symmetrical group f a method is given for the construction of a canonical basis in the tensor space by means of S coefficients. Methods for the calculation of these S coefficients are indicated. By means of the S coefficients the apparatus for the representation of the f group is reduced to the theory of angular momentum. A generalized method is developed for different SU_n groups. A calculation is made of the relativistic fractional percentage coefficients. A theoretical group scheme is proposed for the investigation of complex physical systems. (tr-auth)

28047 CONFORMAL GROUP, ITS CASIMIR OPERATORS, AND A FOUR-POSITION OPERATOR. Lagu, S.; Laue, H. (Univ. of Calgary, Alberta). Nuovo Cim.; 20A: No. 1, 217-231(1 Mar 1974).

A class of representations of the conformal group which are physically interesting because there exists a position-time 4-vector operator within them is investigated, and, related to this, because they are used in field transformation laws. It is shown that in these representations the three Casimir operators of the group have a very simple interpretation; it is discussed when these representations are irreducible, and it is shown that this 4-position operator can be expressed in terms of the generators of the group. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstract 27917.

28048 (SLAC-167(Vol.2), pp 23-34) PRESENT STATUS OF CP VIOLATION. Schwartz, M. (Stanford Linear Accelerator Center, CA). Nov 1973.

In Proceedings of Summer Institute on Particle Physics, July 9-28, 1973. Volume II.

The review of CP violation includes the phenomenological background and the experimental situation for K^0 decay, interference, and regeneration. (JFP)

28049 PHENOMENOLOGICAL DYNAMICS FOR CP VIOLATION. Singer, M.; Schechter, J. (Physics Department, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 8: No. 11, 3866-3874 (1 Dec 1973).

A fairly general current-current form for the CP-violating interaction is investigated in the phenomenological Lagrangian framework. Special attention is given to the computation of both the CP-conserving and CP-violating self-masses in the K_L-K_S system. In addition the relevant amplitudes appearing in the neutral-kaon decay matrix are calculated. We find that several kinds of models naturally give the same results as the superweak theory, within present experimental accuracy. (auth)

28050 CP NONCONSERVATION AND SPONTANEOUS SYMMETRY BREAKING. Lee, T. D. (Columbia Univ., New York). Phys. Rep.; 9C: No. 2, 143-177(Jan 1974).

The observed CP violation is assumed to be due to the spontaneous symmetry-breaking mechanism; the Lagrangian is CP invariant but its particular solution is not. The general classification of such theories when coupled with different unified gauge models of the weak and electromagnetic interactions is given. All such theories lead naturally to a basically milliweak CP noninvariant solution. The possibility that for most weak transitions the result may resemble a superweak theory is analyzed, and possible experiments to distinguish these two different types of theories are discussed. Detailed calculations for various CP violating amplitudes are carried out for a generalized Georgi-Glashow model. (auth)

28051 FIVE-DIMENSIONAL ORTHOGONAL GROUPS AND SOME ASPECTS OF QUANTUM ELECTRODYNAMICS. Lizin, I. M.; Shelepin, L. A. Tr. Fiz. Inst., Akad. Nauk SSSR; 70: 221-270(1973). (In Russian).

A mathematical apparatus is developed for the finite-dimensional representation of O(5), O(4.1), and O(3.2) groups and unitary representation of the de Sitter group O(4.1). Representations of the complete groups including reflection are constructed. An infinitesimal method is developed for the calculation of the Clebsch-Gordan coefficients. Coefficient tables are given. A method for the calculation of the matrix elements of the de Sitter group representation is developed. The five-dimensional symmetries of the cross section of electromagnetic interaction and the possible generalization of quantum electrodynamics on the basis of the apparatus developed are discussed. (tr-auth)

28052 CP VIOLATION IN A GAUGE THEORY OF THE WEAK AND ELECTROMAGNETIC INTERACTIONS. Ballin, D.; Love, A. (Univ. of Sussex, Brighton, Eng.). Nucl. Phys.; B69: No. 1, 142-156(1974).

Spontaneous violation of CP invariance is investigated in a model which combines the Salam-Weinberg theory of weak and electromagnetic interactions with the σ-model for the strong interactions. (auth)

Applications (Strong)

Refer also to abstracts 27952 and 27974.

28053 (COO-3285-8) BROKEN CONFORMAL SYMMETRY AND HADRONIC SCALING. Yunn, B. C. (Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Physics). May 1973. 102p. Dep. NTIS $8.25.

High energy, large momentum transfer hadronic reactions are studied in the framework of a broken conformal symmetry. In the conformal symmetry limit, hadrons are assigned phenomenological fields which belong to infinite dimensional irreducible representations of a pseudo unitary group SU (2,2), which is homomorphic to the conformal group, and also their effective action is conformal invariant. Studying simple Lagrangian models, it is conjectured that the conformal symmetry is spontaneously broken and also that the scalar field χ(the Goldstone boson), which has nonvanishing vacuum expectation value, has a scale dimension $d = -2 + 2\delta$ where δ represents deviation from the canonical dimension. The inverse propagator is calculated up to and including the first order in the tadpole expansion explicitly and it is found that hadrons lie on almost linear Regge trajectories, which are determined by regular null surfaces of the inverse propagator. The widths of resonances are connected to the anomalous part of the dimension, δ. Empirical fit with the data (baryon resonances) gives $\delta \sim 0.04$. In this framework inclusive reactions of the type $p_1 + p_2 \rightarrow q + X$ are also studied in regions of high transverse momenta. On studying the absorptive part of the six-point conformal amplitude, it is found that the single particle distributions exhibit a parton-like structure and also obey simple scaling laws; presently available experimental data on the reaction $pp \rightarrow \pi^0 X$ support this conclusion. Large rates of heavy particles (K, η) production are also predicted. (auth)

28054 GENERAL SU(3) PARTICLE MIXING AMONG MESONS IN SU(3) SUM RULES. Laan'an, T.; Omeda, S. (Center for T Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742); Matsuda, S. Phys. Rev. D 8: No. 11, 4076-4079 (1 Dec 1973).

The features of general SU(3) particle mixing among mesons are studied in the framework of asymptotic SU(3), chiral SU(3) ⊗SU(3) charge algebra, and the hypothesis of asymptotic level realization of SU(3) in the algebra $[A_i, A_j] = i f_{ijk} V_k$. In the level scheme of a simple quark model, our framework requires that the mixings between the corresponding members of two nonets with the same J^{PC} but different L excitations should take place in such a way that their net effect disappears from the sum SU(3) rules, leaving the previously obtained nonet structure of bosons intact. We thus need to consider, in effect, only the usual mixings between the I = Y = 0 members of each nonet (with the same L) and also, less importantly, the mixings between the I = 1/2 members of two nonets with the same J^P and L but opposite C. These mixing parameters are fixed in our theoretical framework. (auth)

28055 COMMENT ON U(6) × O(2) -SYMMETRY BREAKING. Freund, P.G.O. (The Enrico Fermi Institute, and the Department of Physics, The University of Chicago, Chicago, Illinois 60637). Phys. Rev. D 8: No. 12, 4631-4634 (15 Dec 1973).

It is shown that if U(6) × O(2) symmetry is "l-broken," then there must exist Carlitz-Kislinger (CK) branch points in the complex angular momentum plane. In view of experimental and theoretical indications against their existence, modifications of "l-breaking" are considered that do not lead to CK cuts. The approach to U(6) × O(2) breaking based on the Melosh transformation and partial conservation of axial-vector current appears to be free of this difficulty. (auth)

28056 SU(3) -SYMMETRIC COUPLING OF MESONS TO BARYONS AND THE STRONG D/F RATIO. Meiere, F.T. (Physics Department, Indiana-Purdue University, Indianapolis, Indiana 46205); Fischbach, E.; McDonald, A.; Nieto, M.M.; Scott, C.K. Phys. Rev. D 8: No. 11, 4209-4212 (1 Dec 1973).

Pseudoscalar-meson-baryon-baryon (PBB) couplings are analyzed in both the Klein-Gordon (KG) and Duffin-Kemmer-Petiau (DKP) formalisms. Present determinations of these coupling constants indicate that both the pseudoscalar (ps) and pseudovector (pv) KG couplings are in relatively poor agreement with SU(3), whereas the pv DKP coupling is in excellent agreement with SU(3). Furthermore, the value $\beta = D/(D + F) = 0.71 \pm 0.07$ extracted from the DKP coupling is close to the canonical SU(6) value $\beta = 0.6$. (auth)

28057 SATURATION OF CHIRAL SU(2) ⊗ SU(2) ALGEBRAS. $A_1\rho\pi$ AND ρ' COUPLINGS. Matsuda, S. (Department of Physics, Polytechnic Institute of Brooklyn, Brooklyn, New York 11201); Huang, C.Y.; Oneda, S. Phys. Rev. D 8: No. 11, 4133-4141 (1 Dec 1973).

The inter-relation between the two different types of sum rules, the chiral SU(2) × SU(2) spectral function sum rules and the ones based on the saturation of the chiral SU(2) × SU(2) charge algebras (which also includes the time derivative of axial-vector charge) especially studied by Gilman and Harari (G-H), is investigated through the charge-charge density algebras and under the same single-particle approximation. It is shown that, if the ρ meson is the only I = 1 vector meson, (i) the G-H saturation is justified for the case of helicity λ = 0, (ii) the whole set of sum rules is entirely consistent with each other, including the second-spectral-function sum rules, and (iii) $m_{A^2} \simeq 2m_{\rho}^2$ thus follows to the extent that the KSRF (Kawarabayashi-Suzuki-Riaduddin-Fayyazuddin) relation is experimentally satisfied. The modification due to the addition of the newly discovered ρ' meson to the scheme is studied. It is found that the ρ' cannot play a dominant role and its relevant couplings, $\rho'\pi\pi$ and $\rho'-\gamma$, are restricted to small values. Typically, we obtain $\Gamma(\rho' \rightarrow \pi\pi) \simeq 0.2$, if the ρ' is treated as the triplet D states of the quark model and no more vector mesons are introduced. Some remarks are also made about the $A_1\rho\pi$ coupling. (auth)

28058 TESTS OF HIGHER SYMMETRIES. Kayser, B. (Northwestern University, Evanston, Illinois 60201); Lipkin, H.J.; Meshkov, S. Phys. Rev. D 8: No. 11, 4193-4198 (1 Dec 1973).

Model-independent cross section relations predicted by unbroken SU(3) symmetry, and some predicted by SU(6) $w_{,strong}$, are compared with experiment. The relations are found to be satisfied, apart from deviations which follow, in every case, the pattern and rough size of symmetry breaking expected from Regge-pole exchange. Interestingly, this Regge symmetry breaking diverges with increasing energy. It is argued that this behavior, though contrary to intuition, is reasonable. (auth)

28059 POSSIBLE SU(3) CLASSIFICATION OF E MESON. Capps, R.H. (Physics Department, Purdue University, West Lafayette, Indiana 47906). Phys. Rev. D 8: No. 11, 4202-4203 (1 Dec 1973).

We point out that the 1420-MeV E meson cannot be a pure SU(3) singlet. We discuss the possibility, suggested earlier, that the E is a tenth member of the pseudoscalar meson multiplet of the pion. The $(K\bar{K}^* + \bar{K}K^*)$ decay partial width, calculated from an extension of Odorico's bootstrap condition for pseudoscalar mesons, is consistent with experiment. (auth)

28060 LOW ORDER MASS SPECTRUM CONSTRAINTS FROM AN SU(3) × SU(3) CHIRAL ALGEBRA MIXING OPERATOR. Firth, R. J. (Univ. of Durham, Eng.). Nucl. Phys.; B70: No. 1, 51-60 (1974).

It was proposed that a unitary operator, $U(\theta)$, connects axial charges with the generators $A(\lambda_i\sigma_\alpha)$ of SU(6) and the form of this operator has been partially determined up to second order using a perturbative approach. The details of this operator are obtained and then it is applied to find its implications on the mass spectrum at low order in θ. In particular it is found that the $(\text{mass})^2$ equation $3m_B^2 = 2m_{A_2}^2 + m_{A_6}^2$ holds up to corrections of order θ^4. (auth)

Scattering Theory

Refer also to abstracts 27995 and 28569.

28061 (JINR-P4-7689) BOUNDARY-CONDITION MODEL IN THE TWO- AND THREE-BODY PROBLEM. Efimov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

It is shown that in the boundary-condition model the off-shell t-matrix can be evaluated basing only on conditions imposed on the off-energy-shell wave function. In the three-body problem the boundary-conditions can be expressed as integral equation. The method for algebraic solution of this equation that confines the solution of the three-body problem to that one for the system of one-dimensional integral equations is presented. The rank of the latter is determined by the full momentum of the system and by a number of considered partial components. (auth)

28062 ZEROS OF THE SCATTERING AMPLITUDE IN THE COMPLEX ANGLE PLANE. Gersten, A. (Univ. of the Negev, Beersheba, Israel). Nucl. Phys., A219: No. 2, 317-331(1974).

The possibility of reconstructing the scattering amplitude with the aid of the zeros in the complex cos θ plane of the differential cross section is considered. The reconstruction process is demonstrated in two examples. The location of the zeros of the scattering amplitude is examined for the strong absorption and optical models. It appears that there exists a correlation between the position of the zeros and the strength of the absorption. (auth)

28063 INFINITE QUANTUM SYSTEMS. Haag, R. (Univ., Hamburg). Lect. Theor. Phys.; 14B: 251-280(1973).

A somewhat deeper understanding of the relation between spin and statistics is found. Also symmetry between charge conjugate sectors is shown. It can be demonstrated that the statistics parameters determine the metric of the scattering states and thereby enter into expressions for cross sections. Quantum statistical mechanics and quantum field theory are mentioned as possible applications. (JFP)

28064 MULTIPARTICLE VARIABLES FOR HIGH-ENERGY REACTIONS. Foster, M.; Loveless, R.J.; Nussinov, S. (Department of Physics and Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11790). Phys. Rev. D 8: No. 11, 3848-3856 (1 Dec 1973).

A new approach to the analysis of detailed high-energy experiments leading to multiparticle final states is suggested. We construct several multiparticle variables, i.e., variables whose value depends in each event on all or most of the particles produced in this event. The one-dimensional distributions of such variables offers a clearer distinction between the various models and pictures for multiparticle processes and could conceivably facilitate the discovery of new patterns. (auth)

28065 HIGHER-ORDER CORRECTIONS OF THE MODIFIED WKB APPROXIMATION TO THE SOLUTION OF THE REPULSIVE SINGULAR POTENTIAL. Lu, P.; Wald, S.S. (Department of Physics, Arizona State University, Tempe, Arizona 85281). Phys. Rev. D 8: No. 12, 4371-4374 (15 Dec 1973).

We extend the modified WKB approximation due to Miller and Good to the $\hbar^4$ order for the scattering case by the repulsive inverse-fourth-power potential. Instead of describing the higher-order terms by the phase-integral formula in terms of line integrals with a specific contour in a complex plane, we present the formula here in terms of definite integrals. (auth)

28066 BILINEAR BETHE-SALPETER EQUATION AND CONDITIONS FOR A BOUND ON A TWO-PARTICLE REDUCIBLE PART OF THE ELASTIC SCATTERING AMPLITUDE. Davidson, M. (Physics Department, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). Phys. Rev. D 8: No. 12, 4438-4447 (15 Dec 1973).

A high-energy bound is obtained for the full two-particle reducible amplitude in the crossed channel, provided that the Froissart bound is satisfied by the full off-mass-shell amplitude, and the Gribov finite-mass hypothesis is correct for asymptotic amplitudes. Implications of this bound are discussed. (auth)

28067 SPECTRAL FORMS FOR FOUR-POINT FUNCTIONS. Ivanetich, R.J. (Department of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 8: No. 12, 4545-4564 (15 Dec 1973).

Continuing the program initiated in a recent work on three-point functions, we present a detailed study of the establishment in source theory of spectral forms for four-point functions. Both single- and double-spectral forms are treated, and the particles are all allowed different masses (although some inequalities among the masses are employed). Most of the work is carried out for the lowest-order nontrivial contributions, but some considerations are also presented for higher-order contributions. The major new element here, relative to the three-point-function work, is the matter of mass extrapolation. That is, the double-spectral form as first obtained refers to external particles with certain off-shell momenta, since it is derived from a causal realization of the amplitude in which the momenta are thus specified. So one must then extrapolate to real external particles, and that in turn causes an extrapolation of the original spectral-mass domain. A somewhat different extrapolation occurs for the single-spectral form. The paper concludes by generally reviewing the source-theoretic procedures for establishing spectral forms, with some speculations regarding further developments, and by presenting a brief comparison with the conventional analytic approaches. (auth)

28068 COMPARISON OF EIKONAL AMPLITUDES FOR POTENTIAL SCATTERING. Berriman, B.J.; Castillejo, L. (Department of Physics and Astronomy, University College London, London, WCIE, 6BT, England). Phys. Rev. D 8: No. 12, 4647-4652 (15 Dec 1973).

A comparison is made between a number of recently proposed approximations of the eikonal type for potential scattering. The simple amplitudes proposed by Glauber, and later by Abarbanel and Itzykson, are found to be as good as any of the approximations studied. (auth)

28069 SPIN STRUCTURE OF EXCHANGE PROCESSES. Lam, K.; Moravcsik, M.J. (Institute of Theoretical Science and Department of Physics, University of Oregon, Eugene, Oregon 97403). Phys. Rev. D 8: No. 11, 4034-4038 (1 Dec 1973).

It is shown that the spin structure of a given reaction with a dynamics of one-particle or one-Reggeon exchanges can be reduced to a few simple cases, and hence one can easily devise experimental tests for the validity of all such dynamics in terms of specific and simple polarization experiments. (auth)

28070 NEW BOUND FOR THE TOTAL CROSS SECTION. Balachandran, A.P. (Physics Department, Syracuse University, Syracuse, New York 13210). Phys. Rev. D 8: No. 11, 4003-4004 (1 Dec 1973).

We show that the following bound is valid at any given energy: $\sigma_1 \leq \sigma_2 + (1/2)\,[\,(2\bar{n}-5)\,\Sigma_0 + [(2\bar{n}-5)^2\Sigma_0^2 + 8(\bar{n}-2)\,\sigma_2\Sigma_0]^{1/2}]$. Here, σ_n is the cross section for the production of n particles, $\Sigma_0 = \max_{n\geq 2}\sigma_n$, and n is the average multiplicity. The bounds of Khuri on the Pomeranchuk intercept can be obtained from this equation under his assumptions on σ_2, Σ_0, and $\bar{n}$. (auth)

28071 INCLUSIVE APPROACH TO THE MULTIPLICITY DISTRIBUTION. Mak, S.; Tan, C. (Department of Physics, Brown University, Providence, Rhode Island 02912). Phys. Rev. D 8: No. 11, 4061-4069 (1 Dec 1973).

Starting with the Mueller-Regge assumption, a multiperipheral-like integral equation for the multiplicity generating function is constructed and solved. The integral equation, therefore, involves inclusive parameters only. A one-to-one correspondence between our result and that of matrix. Explicit expressions for the multiplicity distribution and correlations are obtained. Possible applications and generalizations are discussed within the framework of a two-component picture of hadronic productions. (auth)

28072 CONNECTION BETWEEN REGGE BEHAVIOR AND FIXED-ANGLE SCATTERING. Blankenbecler, R.; Brodsky, S.J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Gunion, J.F.; Savit, R. Phys. Rev. D 8: No. 11, 4117-4133 (1 Dec 1973).

The physical origins and dynamical details of Regge behavior are studied by examining a general class of theories which are capable of describing the observed large-momentum-transfer data and extending them into the intermediate-t range. The mechanism responsible for the smooth connection between the deep-scattering region and the Regge region is discussed in detail. We derive a convenient new form of the exact integral equation which describes generalized ladder graphs containing irreducible scattering amplitudes as the rungs. The limiting behavior of the Regge trajectories and residues are then calculated in both the single-channel, and the more realistic coupled-channel cases. The trajectories are found to approach negative constants for large negative momentum transfer and the residues fall as powers in the same limit. Furthermore, since the forward and backward Regge regimes must join smoothly onto the same fixed-angle behavior, there are relations between a priori unrelated trajectory functions and residues. The standard properties of Regge poles, in particular factorization and signature, are shown to be present even though the basic, fixed-angle interaction possesses neither of these properties. These general considerations are then applied to the more specific constituent-interchange model. Here we find that the asymptotic behavior of the trajectories and residues are controlled by the form factors of the particles involved in the scattering. Finally, we elucidate the relationship between the constituent-interchange diagrams and the Harari-Rosner duality diagrams. (auth)

28073 TWO-PARTICLE AZIMUTHAL CORRELATIONS IN HIGH-ENERGY COLLISIONS. Pratap, M. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11790); Shaw, J.C. Phys. Rev. D 8: No. 11, 3938-3944 (1 Dec 1973).

The angular correlations between the transverse momenta of particles produced in high-energy collisions are studied. An explicit expression is derived for the so-called minimal azimuthal correlations, in terms of the total cross section and the single-particle distribution function. A simple model is also considered for illustration. Experimental distributions for several π^+p reactions at 8.5 GeV/c and at 20 GeV/c are presented and compared with the minimal correlations. (auth)

28074 CALCULATING THE SCATTERING AMPLITUDE NEAR THE RESONANCE. Kochkin, A. P. Teor. Mat. Fiz.; 18: No. 2, 267-272(Feb 1974). (In Russian).

A direct method of calculating the coefficients in the leading term of the expansion of scattering amplitude near the resonance is proposed, which does not require knowledge of scattering phases. In the anisotropic case the method can be used also for calculating the damping of levels which would be truly bound, if their energy did not lie inside other zones. (auth)

28075 N-REGGEON VERTEX FOR THE GENERALIZED VENEZIANO MODEL. Braun, M. A.; Katona, Z.; Eides, M. I. (Leningrad State Univ.). Teor. Mat. Fiz.; 18: No. 2, 212-225 (Feb 1974). (In Russian).

The N-reggeon vertex for generalized DRM is constructed. This vertex factorizes in any planar channel and possesses simple properties under cyclic permutations of the external reggeons. The construction can be realized both with Bose-like and Fermi-like operators. As special cases of it one obtains the Lovelace N-reggeon vertex for classical Veneziano model and the N-reggeon amplitude for the Neveu–Schwarz model. (auth)

28076 REMOVAL OF A CUT-OFF IN THE T-EXPONENT. Shcherbina, V. A. (Physical-Technical Inst. of Low Temperatures, Kharkov). Teor. Mat. Fiz.; 18: No. 2, 161-173(Feb 1974). (In Russian).

The R-operation introduced by N. N. Bogoliubov is considered for the interaction Hamiltonian $H_{int}(x) = \lambda : \varphi^4(x):$ where $\varphi(x)$ is a generalized free field with space-like regularization. The coefficient functions for the terms of the perturbation theory series for the S-matrix are shown to converge to their renormalized values when the cut-off is removed. (auth)

28077 PROPERTIES OF AN ANALYTICALLY SOLVABLE MODEL OF MULTICHANNEL SCATTERING. Gerber, R. B.; Rosenbach, N. C. (Weizmann Inst. of Science, Rehovot, Israel). Phys. Rev., A; 9: No. 1, 301-315(Jan 1974).

A study is made of an analytically solvable model of multichannel scattering, leading to the derivation of various properties of the solutions. In this model the intrinsic potential in each channel and the interchannel coupling operators are all taken to be separable interactions. In an especially simple version of the model an assumption is also made concerning a factorization property of the coupling coefficients that pertain to these interactions. Extremely simple explicit expressions are obtained for the elastic- and the inelastic-scattering amplitudes, as well as for the Feshbach potential, the effective interaction in the elastic channel owing to the presence of all other channels. The expressions obtained are transparent to analysis, and in the simple version of the model they do not involve the evaluation of inverses or determinants of large matrices, as is the case in general for formal explicit solutions of Fredholm equations. The simple version of the model can also be extended to the case of a continuum of channels, thus being capable of describing systems with open rearrangement or dissociation channels. Within the framework of this model, a rigorous analysis is given for the case of an infinite number of channels, and conditions are obtained for convergence of the close-coupling scheme. Error bounds are obtained for an N-channel truncated calculation on an infinite-channel system. Other results obtained include: establishing the asymptotic behavior of the scattering amplitude at extremely high energies, and deriving some especially simple features, "scaling properties," of the scattering amplitudes. (auth)

28078 REGGEON STRUCTURE, S-CHANNEL UNITARITY, AND THE MANDELSTAM CUT. Halliday, I. G.; Sachrajda, C. T. (Imperial Coll. of Science and Tech., London). Phys. Rev., D; 8: No. 10, 3598-3611(15 Nov 1973).

The allowed s-channel intermediate states in the unitarity equations for the Mandelstam and Amati-Fubini-Stanghellini diagrams. The aim is to contrast them with Abarbanel's analysis of the full unitarity equation. On this basis it is argued that Abarbanel's ansatz for the general production amplitude is incomplete. The details of the calculation depend strongly on the off-mass-shell behavior of the ladder diagrams which are analyzed in some detail. This analysis is also generalized to present arguments against the inclusive-sum-rule proof of the vanishing of the triple-Pomeron vertex at $t = 0$. (auth)

28079 POTENTIAL SCATTERING AND GALILEI-INVARIANT EXPANSIONS OF SCATTERING AMPLITUDES. Kalnins, E. G. (Univ. of Montreal); Patera, J.; Sharp, R. T.; Winternitz, P. Phys. Rev., D; 8: No. 10, 3527-3538(15 Nov 1973).

Previously derived Galilei-group expansions for the four-particle nonrelativistic scattering amplitude are applied to potential scattering and the expansion coefficients (or Galilei amplitudes) are related in the first Born approximation to the potential. For the spherical partial-wave expansion the coefficients require a knowledge of the Clebsch-Gordan coefficients of E(3), and for the cylindrical eikonal expansion they are simply related to the usual eikonal function. A model amplitude containing Breit-Wigner resonances and other k-plane singularities, having correct threshold and reasonable asymptotic behavior, is analyzed in detail. It is shown that poles of partial-wave amplitudes $a_l(k)$ in the k plane correspond to exponential-type asymptotics in the Galilei amplitudes. Specific models, in particular the Bargmann and separable potentials, are examined and their Galilei amplitudes calculated. A Schwinger-type variational principle is given for the Galilei amplitudes. (auth)

28080 SCATTERING AMPLITUDE FOR FOUR DUAL FERMIONS. Corrigan, E. F. (Univ. of Durham, Eng.). Nucl. Phys.; B69: No. 2, 325-335(1974).

The amplitude for the scattering of four dual fermions is written down and evaluated in terms of three complicated functions. One of these is then expressed in terms of the other two. The s-channel spectrum is that of the Neveu-Schwarz model, but it is not possible at present to describe the t-channel spectrum. The spinor structure of the amplitude is also discussed. (auth)

28081 MODIFIED METHOD OF MOMENTS APPROACH TO THE SOLUTION OF SCATTERING EQUATIONS. Harms, E. (Fairfield Univ., CT). Nucl. Phys.; A222: No. 1, 125-139(1974).

A modified form of the method of moments is shown to be an effective procedure for obtaining iterative solutions to linear integral equations of the form $|\psi\rangle = |\phi\rangle + \lambda VG|\psi\rangle$, which appear frequently in quantum scattering theory. After N iterations, this method gives the [N, N−1] Padé approximant to the matrix element $M = \langle\phi|G|\psi\rangle$. This matrix element is often of physical interest. Other Nth-order matrix elements are rational functions of λ having the same denominator as the approximation to M. They agree with the Born series to order N. This approach is therefore more efficient than the more familiar Padé method at summing the iterates of the scattering equations, but requires little additional computational effort. A numerical example using the Lippmann-Schwinger equation exhibits an exponential convergence rate. Useful measures of convergence are obtained. (5 figures) (auth)

28082 REDUCED DENSITY MATRIX WITH NON-ZERO BOUNDARY CONDITIONS IN THE CASE OF HARD CORE. Matvichuk, K. S. (Inst. of Theoretical Physics, Kiev). Teor. Mat. Fiz.; 18: No. 3, 410-426(Mar 1974). (In Russian).

Influence of the non-zero boundary conditions on the reduced density matrix is investigated for the Maxwell–Boltzmann, Bose–Einstein and Fermi–Dirac systems having hard-core potentials. The dependence of the unique solution of the appropriate prelimiting Kirkwood–Salzburg integral equations of the boundary conditions is shown. (auth)

28083 SCATTERING THEORY FOR ELLIPTIC DIFFERENTIAL OPERATORS IN UNBOUNDED DOMAINS. I. Goldstein, C. I. (Brookhaven National Lab., Upton, NY). J. Math. Anal. Appl.; 45: No. 3, 723-745(Mar 1974).

A method based on the limiting absorption principle is demonstrated for meromorphically continuing the S-matrix and distorted plane waves associated with certain elliptic differential operators acting in unbounded domains and for relating the poles to resonant states. The particular operators dealt with are self-adjoint second-order perturbations of the Laplarian associated with zero Dirichlet boundary conditions in wedge-like domains contained in R^N, N-dimensional Euclidean space. Indications are also given as to how these results will be extended to more general operators. (LBS)

28084 INTEGRAL EQUATIONS FOR SCATTERING IN POTENTIALS OF INFINITE RANGE. Freeman, D. F.; Nuttall, J. (Univ. of Western Ontario, London). J. Math. Phys. (N.Y.); 14: No. 12, 1883-1885(Dec 1973).

It is shown how, by finding an approximation to the exact Green's function, one obtains integral equations with compact kernels for two scattering problems involving potentials of infinite range. They are one particle scattering in a Coulomb potential for a given partial wave and one particle scattering in three dimensions in a potential having r^{-2} behavior at infinity. In the second case, only an inhomogeneous version of Schrödinger's equations is solved. (auth)

28085 NORMALIZATION OF THE INELASTIC SCATTERING AMPLITUDES IN MOMENTUM REPRESENTATION. Belgman, I. L. Kratk. Soobshch. Fiz.; No. 8, 10-13(Aug 1973). (In Russian).

A method for the normalization of the amplitudes of the effective

cross section in pulse regime is reported. The method gives results analogous to those of the R-matrix method and is much simpler in the calculation of the ratios. (tr-auth)

28086 COMPLEX POLES, INCREASING CROSS SECTIONS, AND THE THEOREM OF POMERANCHUK. Tsarev, V. A. Kratk. Soobshch. Fiz.; No. 8, 52-55(Aug 1973). (In Russian).

It is shown that the presence of the oscillating contribution, coupled with complex-conjugate Regge poles does not destroy the asymptotic parity of the total scattering cross section of particles and antiparticles on similar targets. Models with complex poles, reduced to asymptotic and pre-asymptotic increase of the total cross section, are discussed. (tr-auth)

28087 RELATIONS BETWEEN HYPERSPHERICAL AND HARMONIC-OSCILLATOR MANY-BODY MATRIX ELEMENTS. Levi, D.; Moshinsky, M. (Universidad de Mexico, Mexico City). Nuovo Cim.; 20A: No. 1, 107-114(1 Mar 1974).

A simple deduction of the relation between many-body matrix element for the Hartree–Fock approximation in the harmonic-oscillator basis and the hyperspherical approach is developed, applying it afterwards to the calculation of a compact formula for the matrix elements for hyperspherical functions. (auth)

28088 ASYMPTOTICAL FORM OF THE THREE-BODY WAVE FUNCTIONS OF THE DISCRETE SPECTRUM. Merkur'ev, S. P. (Leningrad State Univ.). Yadern. Fiz.; 19: No. 2, 447-461(Feb 1974). (In Russian).

The coordinate asymptotics of the discrete spectrum wave functions are studied for the system of three spinless neutral particles. It is shown that the character of the exponential decrease of the eigenfunctions depends on the direction of observation in the configurational space. In the directions of changing the form of the exponential decrease the asymptotics are described by the functions erfc(t). (auth)

28089 RECOUPLING IN A THREE-PARTICLE SYSTEM. Klepikov, N. P. (Moscow State Univ.). Yadern. Fiz.; 19: No. 2, 462-471(Feb 1974). (In Russian).

The partial groupoid of all recouplings in a system of three particles is defined and its structure and representations are studied. Matrices consisting of Racah coefficients form a certain type of representation of this groupoid. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

Refer also to abstract 28523.

28090 (ORNL-TM-4426, pp 34-38) NEUTRON SCATTERING INVESTIGATION OF BOSE–EINSTEIN CONDENSATION IN SUPERFLUID ^{4}He. Mook, H. A. Jan 1974.

From topical conference on atomic and molecular studies; Oak Ridge, Tennessee, USA (22 Mar 1973).

In topical conference on atomic and molecular studies at ORNL, Oak Ridge, Tennessee, March 22-23, 1973.

Measurements were made at the HFIR on a triple-axis spectrometer at a consistent scattering angle of 135° and a momentum transfer of 14.33 $Å^{-1}$. The results of the measurements are shown for ^{4}He at 1.2°K and 4.2°K. The two-component distribution indicative of a condensate is visible at 1.2°K although the effect is quite subtle. (MHR)

28091 INFLUENCE OF AN AC ELECTRIC FIELD ON He II FILM TRANSFER. Esel'son, B. N.; Ivantsov, V. G.; Mikhailov, G. A.; Shcherbachenko, R. I. (Physical-Technical Inst. of Low Temperatures, Kharkov). Phys. Lett.; 47A: No. 1, 29-30(25 Feb 1974).

The helium film transfer rates were found to be reduced considerably under ac field, the phenomenon being controllable and reproducible. The proposed explanation of the phenomenon observed is based on the excitation of He II film thickness oscillations. (auth)

28092 LIQUID FLOW RATES OF SUPERFLUID HELIUM II DURING THERMOMECHANICAL PUMPING THROUGH POROUS MEDIA. Frederking, T. H. K. (Univ. of California, Los Angeles); Elsner, A.; Klipping, G. Advan. Cryog. Eng.; 18: 132-140(1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

The flow rate of He II was investigated experimentally and theoretically as a function of the thermomechanical driving forces for pore sizes of the order of 10^4 cm magnitude. Attention is focused on the flow phenomena of liquid helium (^{4}He), primarily in the superfluid temperature range below the λ-point. To provide the proper background, the classical porous medium conditions and the experimental arrangement used in this study are reviewed first. Next, a theoretical account is considered based on phenomenological equations. These equations are modified for the conditions of thermomechanical pumping through porous media. Finally, the experimental data are compared with the phenomenological description. (MHR)

28093 HELIUM FLOW THROUGH FILTERS. Elsner, A. (Max-Planck-Gesellschaft, Berlin). Advan. Cryog. Eng.; 18: 141-149(1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

In previous studies of helium flow through filters, the filter was immersed in the liquid. This reduced the attainable differences of pressure and temperature across the filter to a few μbar and mK. The investigations presented here were performed with a filter placed above the He II bath. Thus, the filter divided the cryostat into two chambers and only the upper side of the filter was in contact with the vapor of the He II bath. This arrangement permitted measurements across the filter at relatively large pressure and temperature differences. (MHR)

28094 THERMAL EFFECTS IN ROTATING SUPERFLUID HELIUM DUE TO VORTEX MOTION. Phenomenological Model. Vidal, F. (Ecole Normale Superieure, Paris). Compt. Rend., Ser. A, B; 277: No. 22, 675-678(5 Dec 1973). (In French).

A phenomenological model based on the motion of superfluid vortices is used to examine the possible existence of thermal effects in rotating He-II similar to thermomagnetic effects occurring in the mixed state of type-II superconductors. (auth)

28095 ALIGNMENT OF ANISOTROPIC SUPERFLUIDS BY FLOW. De Gennes, P. G. (College de France, Paris); Rainer, D. Phys. Lett.; 46A: No. 7, 429-430(11 Feb 1974).

Some features of one-dimensional superflow in a p-state superfluid are discussed. The direction l of the orbital momentum is anchored at the walls, but l tends to become aligned along the flow lines, when the superfluid velocity exceeds a certain threshold. (auth)

28096 CHEMICAL POTENTIAL AND ONSET OF SUPERFLUIDITY FOR THIN ^{4}He FILMS. Revzen, M.; Rudnick, J.; Schulman, L. S. (Technion-Israel Inst. of Tech., Haifa). Phys. Lett.; 46A: No. 7, 479-480(11 Feb 1974).

The chemical potential of superfluid condensation is calculated within the Gross–Ginzburg–Pitaevskii theory. There results an expression which is a new relation between pressure and film thickness; the effect on third sound propagation is outlined. (auth)

28097 VELOCITY OSCILLATIONS OF A FREELY ROTATING VESSEL WITH HELIUM II. Tsakadze, D. S.; Tsakadze, S. D. (Inst. of Physics, Tbilisi, USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 10, 355-357(20 Nov 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 10, 605-608(20 Nov 1973).

Experiments with free rotation of vessels with helium-II show that the perturbations of the vortex lattice lead to oscillations of the rotation velocity. These data serve as a certain confirmation of the premise that Tkachenko oscillations of the vortex lattice play a role in the behavior of pulsars. (auth)

28098 LOCALIZED STATES OF ROTONS NEAR IONS IN HELIUM II. Bondarev, V. N. (Odessa State Univ.). JETP Lett. (USSR) (Engl. Transl.); 18: No. 11, 405-409(5 Dec 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 11, 693-696(5 Dec 1973).

It is shown that localized roton states, due to polarization of the helium by the ion, exist near the surface of a positive ion. The additional contribution made to the mobility of the positive ion is calculated on this basis. (auth)

28099 STRUCTURE OF ELECTRON BUBBLES IN LIQUID HELIUM UNDER PRESSURE. Shih, Y. M.; Woo, C. W. (Northwestern Univ., Evanston, IL). Phys. Rev., A; 8: No. 3, 1437-1439(Sep 1973).

A simple calculation of electron-bubble radii in He II under pressure is presented here. An approximation for the two-particle density function is used which is identical to a scheme employed earlier for calculating the surface tension of He^4 and surface states of He^3 in solutions. There are no adjustable parameters, and the agreement with experiment is excellent. The approximation is proposed as a unifying model for all experiments involving helium surfaces. (auth)

28100 ELECTRONIC SURFACE STATES ON LIQUID HELIUM. Huang, H. M. (National Tsing Hua Univ., Taiwan); Shih, Y. M.; Woo, C. W. J. Low Temp. Phys.; 14: No. 5/6, 413-418(Mar 1974).

Beginning with a microscopically obtained density profile near the free surface of liquid helium an analysis of the electronic surface states, both inside and outside, is carried out. For the potential barrier seen by electron bubbles trapped inside the surface layer an upper bound of 38 K is found, in comparison with experimental values ranging from 25 to 30 K. For outside states a binding energy of 9 K and a hydrogenlike spectrum is found. There are no adjustable parameters in the theory. (auth)

28101 SEARCH FOR A DISCONTINUITY IN THE DENSITY OF LIQUID ^{3}He BELOW 3 mK. Bukshpan, I.; Eckstein, Y.; Landau, J. (Technion–Israel Inst. of Tech., Haifa). Phys. Rev., A; 8: No. 6, 3093-3095(Dec 1973).

The density of liquid ^{3}He along the melting curve below 3 mK and through the transitions to the A and B phases has been studied using a parallel-plate capacitor in a Pomeranchuk cell. It is found that the density varies smoothly in this region with no discontinuity larger than $\Delta\rho/\rho \approx 5 \times 10^{-5}$. The existence of a latent heat demonstrates that the B transition is first order; however, the jump in density must be minute. (auth)

28102 ENERGY SPECTRUM OF ^{3}He QUASIPARTICLES IN ^{3}He–^{4}He SUPERFLUID SOLUTIONS. Sobolev, V. I.; Esel'son, B. N. (Physical-Technical Inst. of Low Temperatures, Kharkov). JETP Lett. (USSR) (Engl. Transl.); 18: No. 11, 403-405(5 Dec 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 11, 689-692(5 Dec 1973).

On the basis of an analysis on the data on the temperature dependence of the density of the normal component, it is concluded that there can exist new singularities of the energy spectrum of ^{3}He quasiparticles in ^{3}He–^{4}He superfluid solutions. (auth)

Superconductivity

Refer also to abstracts 27866 and 28523.

28103 (AD-766659-7) MEASUREMENT OF THE PROBABILITY DISTRIBUTION OF THERMALLY EXCITED FLUXOID QUANTUM TRANSITIONS IN A SUPERCONDUCTING RING CLOSED BY A JOSEPHSON JUNCTION. Jackel, L. D.; Webb, W. W.; Lukens, J. E.; Pei, S. S. (Cornell Univ., Ithaca, N. Y. (USA). Materials Science Center). 10 Sep 1973. Contract N00014-67-A0077-0016. 18p. (MSC-2091). NTIS $2.75.

The thermally induced distribution of transitions between fluxoid quantum states of a superconducting ring closed by a Josephson junction has been measured. The observed dependence of its width on temperature, ring inductance, and weak link critical current, as well as its shape confirm the recent theoretical results of J. Kurkijarvi. (GRA)

28104 (INIS-mf-43) SUPERCONDUCTING POINT CONTACTS WEAKLY CONNECTING TWO SUPERCONDUCTORS AND ELECTROSTATIC EFFECTS IN SUPERCONDUCTORS DUE TO TEMPERATURE GRADIENTS. Part I. de Waele, A. T. A. M. (Rijksuniversiteit Leiden (Netherlands)). 21 Dec 1972. 67p. INIS.

The macroscopic quantum effects in superconducting point contacts weakly connecting two superconductors are described. In the case of a single point contact attention is paid to the resistive-superconductive region, the current–voltage characteristic and the radiative properties. The point contact is treated using a two-fluid model in which the total current is the sum of an ideal Josephson supercurrent and a normal current. The influence of a shunt capacitance and a series inductance is not neglected. The magnetic field dependence of the critical current (the dc Josephson effect) through a double point contact, when the self-induced flux in the enclosed area is taken into account, has been studied. Its relation with flux quantization is discussed. The properties of double point contacts in the resistive-superconductive region are considered in relation with both the ac and dc Josephson effects. Device applications such as in very sensitive magnetometers and voltmeters are discussed. An experiment is described where a double point contact is used to measure the magnetic flux due to a rotating superconductor (the London moment). A description of the experimental set-up and the construction of the used devices is given. (auth)

28105 (INIS-mf-968) SUPERCONDUCTING POINT CONTACTS WEAKLY CONNECTING TWO SUPERCONDUCTORS AND ELECTROSTATIC EFFECTS IN SUPERCONDUCTORS DUE TO TEMPERATURE GRADIENTS. Part II. de Waele, A. T. A. M. (Rijksuniversiteit Leiden (Netherlands)). 21 Dec 1972. 36p. INIS.

An electrostatic voltage difference in a superconductor due to a temperature difference has been observed, although the Thompson, Seeback and Peltier coefficients are zero. This electrostatic voltage difference is due to the temperature dependence of the chemical potential of the electrons. It cannot be interpreted in the same simple terms as the pressure difference in the fountain effect in helium II. It can be derived that the energy gap in a superconductor gives only a second-order contribution to the chemical potential per electron. Electrostatic voltage differences due to a difference in the chemical potential per electron cannot be measured by connecting two wires to the sample. Therefore a capacitive coupling was used and the work function change of the superconductor was measured. The work function is equal to the chemical potential per electron plus a contribution due to the dipole layer at the metal surface. The measured changes in the work function of the samples were as small as 0.5 t.V. No discontinuity was detected at the critical temperature of the superconducting samples (niobium and lead). The signal was an order of magnitude larger than the value estimated from the thermal expansion effect. (auth)

28106 (LBL-1805) PROPERTIES OF TUNNEL JUNCTIONS WITH FLUOROCARBON DIELECTRIC BARRIERS. Jack, M. D. (California Univ., Berkeley (USA)). Nov 1973. 117p. Dep. NTIS $8.00.

Thesis.

The electrical characteristics of In/I/In and In/I/Pb superconducting tunnel junctions have been studied in detail. Since In does not readily form pinhole free oxide layers, a thin insulating dielectric was formed on freshly deposited In film by passing an electric discharge through an atmosphere of fluorocarbon gas. Junctions were then completed by depositing a thin counter electrode of In or Pb. The same process was used to prepare high resistance junctions with Au as the base electrode; these were not however, studied in detail. In/I/In and In/I/Pb junctions were produced with resistances in the range 0.01 ohms to 10^{10} ohms at liquid helium temperatures. Low resistance junctions exhibited nonlinear electrical characteristics associated with good quality "oxide" superconducting junctions including (a) the dc Josephson effect, (b) quasiparticle tunneling characteristics, (c) phonon structure and (d) inelastic tunneling phenomena. The magnitude of the Josephson current for In/I/In junctions agreed to within a few percent of the value predicted by strong coupling theory. Current voltage (I–V) and first and second derivative curves for In/I/In and In/I/Pb were compared with curves for Al/I/In and Pb/I/Pb junctions. Discrepancies between the characteristics can be, for the most part, explained on the basis of existing theories of phonon mediated superconductivity using recent data from inelastic neutron scattering studies of In. Nonlinear structure at voltages below the phonon spectrum was observed and is most likely associated with Kohn singularities. At higher voltages, second derivative curves exhibited resonances characteristic of CH and OH impurities in the barrier as well as a complex spectrum associated with the vibrational spectrum of the fluorocarbon dielectric. To better characterize this dielectric, a variety of surface analytic techniques were used to determine the complex index of refraction, the chemical composition and chemical homogeneity of the barrier. I–V curves for high resistance junctions were used to determine the potential at the metal-insulator interface. (auth)

28107 ENERGY GAPS AND TRANSITION TEMPERATURES OF ULTRATHIN SUPERCONDUCTING FILMS. Sixl, H.; Gromer, J.; Wolf, H. C. (Univ., Stuttgart). Phys. Lett.; 47A: No. 1, 47-48(25 Feb 1974).

Energy gaps and transition temperatures of extremely thin aluminum, indium and lead films, deposited on SiO or naphthalene, depend on the film thickness up to about 300 Å. This dependence is due to quantum size effects and to surface interactions. (auth)

28108 CALCULATION OF THE SURFACE CRITICAL FIELD H_{c3} FOR A CYLINDRICAL CAVITY. Hauser, J. R.; Wang, J. S. Y.; Kittel, C. (Univ. of California, Berkeley). Phys. Lett.; 47A: No. 1, 34-36(25 Feb 1974).

The linearized Landau–Ginzburg equation is used to calculate H_{c3} for a cylindical cavity in a type-II material. H_{c3} exhibits oscillations as a function of the cavity radius R when R is of the order of the coherence length. H_{c3} increase to the Saint-James and De Gennes limit for large R. (auth)

28109 EFFECT OF HYDROGEN CONCENTRATION ON SUPERCONDUCTIVITY AND CLUSTERING IN PALLADIUM HYDRIDE. Harper, J. M. E. (Stanford Univ., CA). Phys. Lett.; 47A: No. 1, 69-70(25 Feb 1974).

A method of preparing superconducting palladium hydride by electrolysis is described. The relationship of the superconducting transition temperature to hydrogen concentration and the behavior of the hydrogen clustering temperature at high concentrations are reported. (auth)

28110 PREPARATION, SUPERCONDUCTING PROPERTIES, AND STRUCTURE OF TECHNETIUM FILMS. Golanov, V. M.; Elesin, L. A.; Mikheeva, M. N. JETP Lett. (USSR) (Engl. Transl.); 18: No. 9, 335-337(5 Nov 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 9, 569-572(5 Nov 1973).

Technetium films were obtained by the ion sputtering method. The dependence of the critical temperature, resistance, and structure of the film samples on their thickness was investigated. For films of thickness d < 150 Å a new modification was observed stable at room temperature and having an FCC structure with lattice parameter $a_0 = 3.68 < 0.05$ Å. (auth)

28111 TEORIYA FERMI-GAZA. (Theory of Fermi Gases). Tolmachev, V. V. Moscow; Izdatel'stvo Moskovskogo Universiteta (1973). 353p.

The theory of weakly nonideal Fermi gases, one of the important problems of contemporary quantum statistical physics, is examined. The Fermi gas model is used in the electron theory of metals in the explanation of the effect of superconductivity, in the theory of liquid He-3 and in the theory of infinite nuclear matrix. Some important results of the Fermi gas theory are discussed. The possibility of the appearance of two-Fermion bound states is investigated. The criteria of superconductivity are studied. The general formalism of the adiabatic perturbation theory, developed for degenerate states of discrete spectra and for states of continuous spectra, is discussed. The concepts, methods, and principles in the construction of the theory of weak coupling in Fermi gas has significance for other areas of contemporary theoretical physics. (tr-auth)

28112 SELF-CONSISTENT TREATMENT OF A PHASE TRANSITION IN A SYSTEM WITH A VECTOR ORDER PARAMETER. Zannetti, M. (Univ., Salerno, Italy). J. Statist. Phys.; 10: No. 1, 1-9(Jan 1974).

The problem of the continuation of the Hartree approximation below the transition temperature is considered for a system

with a vector order parameter. In contrast to the case of a scalar order parameter, considered in a previous paper, it is found that a self-consistent and gapless approximation can be constructed in the limit of a very large number of vector components. The results agree with those of the spherical model. (auth)

28113 CRITICAL CURRENT OF A 50 AT. % Nb–Ti ALLOY AS A FUNCTION OF TEMPERATURE AND MAGNETIC FIELD. El Bindari, A. (Supertechnology Corp., Boston). Advan. Cryog. Eng.; 18: 423-426(1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

Experiments carried out on the alloy in the heat-treated condition (450°C for 1½ hr) are described. The critical current of this alloy was determined as a function of temperature and magnetic field. The experimental procedures and results are described briefly. (MHR)

28114 LIFETIME OF QUASI PARTICLES IN THE B-C-S THEORY OF SUPERCONDUCTIVITY. Bar'yakhtar, V. G.; Seminozhenko, V. P. (Donets Physical-Technical Inst., USSR). Fiz. Metal. Metalloved.; 36: No. 5, 914-918(Nov 1973). (In Russian).

The lifetime of quasi particles was calculated relative to processes of phonon dispersion, recombination, and decay of Cooper pairs in superconductors. Possible energies of quasi particles were calculated over a wide range of temperatures. In the limiting case, $T \ll T_c$ and $T_c - T \ll T_c$, where T_c is the superconducting transition temperature, answers were found in analytical form; in other cases the results were obtained by numerical methods. Recombination and decay were shown to occur much more slowly than dispersion of quasi particles on phonons at low temperatures. The quasi particle recombination rate is proportional to $(\Delta_0/T)^{-5} \exp(-\Delta_0/T)$, where Δ_0 is the energy gap at absolute zero. For quasi particles with energy close to Δ_0, the dispersion rate is a function of T^3. If the energy is much greater than Δ_0, the dispersion time has only a slight dependence on temperature and is a function of energy only. In the critical temperature region ($T_c - T \ll T_c$), the rate of the two processes becomes comparable and proportional to T^3. (tr-auth)

28115 CONDUCTIVITY OF QUASI-ONE-DIMENSIONAL CRYSTALS IN THE METALLIC PHASE. Gor'kov, L. P.; Dzyaloshinskii, I. E. (Inst. of Theoretical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 11, 401-403(5 Dec 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 11, 686-689(5 Dec 1973).

The connection between structural instability and the possible appearance of superconductivity is noted. Attention is confined here only to sufficiently high temperatures, when the fluctuations do not play an essential role, but nevertheless the behavior of all physical quantities exhibits certain singularities inherent in one-dimensional systems. (MHR)

28116 FUNCTIONAL INTEGRAL REPRESENTATION OF LANDAU–GINZBURG THEORY WITH FLUCTUATIONS. Strickfaden, W. B. (Univ., Utrecht). Physica; 70: No. 2, 320-338 (1 Dec 1973).

Starting from a hamiltonian for a system of fermions with an attractive potential between pairs of particles with opposite spin a functional integral representation for the grand partition function is derived. For small values of the order parameter and temperatures close to the transition temperature the functional integral is simplified and leads to a Landau–Ginzburg theory which includes spatial and quantum fluctuations of the order parameter. The result shows clearly the relation between Bose condensation and the formation of bound Cooper pairs in superconductivity. The question of particle nonconservation in the usual developments is avoided. Some comments are made concerning the evaluation of functional integrals and on the question of phase coherence in superconductivity. (auth)

28117 THEORY OF VOLT–AMPERE CHARACTERISTICS OF ONE-DIMENSIONAL s–n–s AND s–n JUNCTIONS. Volkov, A. F. (Inst. of Radio Engineering and Electronics, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 2, 758-765(Feb 1974). (In Russian).

The field and current distribution and also the volt–ampere characteristic of a one-dimensional Josephson junction of the s/n/s type or a Notarys bridge type are calculated on basis of the nonstationary Ginzburg–Landau equations. In the model under consideration the phase of the order parameter Ψ varies over a characteristic distance $\xi I_c/I_{cs} \ll \xi$ (I_c is a critical Josephson current, I_{cs} is the critical superconductor current) and the electric potential and $|\Psi|$ vary over the correlation length ξ. The resistance of the s–n junction and its dependence on the current passing through the junction are also calculated. (auth)

28118 TEMPERATURE DEPENDENCE OF THE VELOCITY OF ULTRASOUND IN SUPERCONDUCTING TIN. Fil, V. D.; Denisenko, V. I.; Bezuglyi, P. A. (Physical-Technical Inst. of High Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 66: No. 2, 766-775(Feb 1974). (In Russian).

Data are presented on the variation of the velocity of high frequency ultrasound waves in the superconducting transition in tin. It is shown that near T_c the contribution to the velocity of transverse sound is satisfactorily described by the Ozaki and Mikoshiba theory [Phys. Lett., 23, 52, (1966)]. The major effect on the velocity at a distance from T_c is exerted by the dislocation structure of the sample. An anomalous behavior of the quantities measured is observed in samples with a sound wave vector $q \parallel [110]$ and polarization $\epsilon \parallel [110]$. (auth)

28119 EFFECT OF HELIUM ATOM INJECTION ON THE SUPERCONDUCTING PROPERTIES OF INDIUM FILMS. Fogel, N. Ya.; Moshenskii, A. A.; Dmitrenko, I. M.; Tishchenko, L. P.; Peregon, T. I.; Fogel, Ya. M. (Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 66: No. 2, 626-634(Feb 1974). (In Russian).

The characteristics of the superconducting transition (T_c, $H_{c\perp}$, $H_{c\parallel}$) of thin indium films irradiated by various doses of helium ions are measured. Injection of helium particles leads to a pronounced increase of $H_{c\perp}$ and $H_{c\parallel}$ due to decrease of the electron mean free path and to an insignificant increase of T_c of the indium films. On basis of the experimental results and of a comparison of the experimental and theoretical results of other authors it is concluded that the method of injecting helium atoms into thin superconducting metallic films permits one to study under a broad range of conditions and in a purer form the effect of the mean free path length of electrons in a metal on the superconducting properties of thin films. (auth)

28120 QUANTUM OSCILLATIONS AND REVERSIBLE AND IRREVERSIBLE SUPERCONDUCTING PHASE TRANSITIONS IN INDIUM MICROCYLINDERS. Michael, P.; McLachlan, D. S. (Univ. of the Witwatersrand, Johannesburg). J. Low Temp. Phys.; 14: No. 5/6, 607-626(Mar 1974).

Using a sensitive mutual inductance method, measurements of first- and second-order phase transitions in indium microcylinders (2.8–7.6 μm in diameter) have been made. Quantum oscillations in the supercooling field have been observed. The values of $\kappa_{SC}(T/T_c) = \kappa_1(T/T_c)$ derived from $H_{SC} = H_{C3}$ have been corrected for both the temperature and the size dependence in the relationship between H_{c2} and H_{c3}. The results for $\kappa_1(T/T_c)$ from the 7.6-μm sample then agree reasonably well with the temperature dependence of κ_1 observed for niobium. However, for the smallest cylinders anomalously low values of κ_{SC} (T/T_c) were obtained near T_c. Very close to the transition temperature second-order (nonhysteretic) phase transitions have been observed and are interpreted in terms of the Ginzburg–Landau theory. (auth)

28121 INFLUENCE OF GALLIUM IMPLANTATION ON THE LOW FREQUENCY LOSSES IN SUPERCONDUCTING VANADIUM. Deprez, E.; Bruynseraede, Y.; Thys, W.; Reynders, L. (Univ., Louvain, Belg.). Phys. Lett.; 46A: No. 7, 458-460(11 Feb 1974).

The ac losses in superconducting vanadium are measured before and after the implantation with 75 keV Ga-ions. A pronounced increase of the surface shielding capacity resulting in a decrease of the energy losses is observed. (auth)

28122 VARIOUS FORMALISMS ON THE MICROSCOPIC THEORY OF SUPERCONDUCTIVITY. Matricon, M. (Thomson-CSF, Paris). Rev. Tech. Thomson-CSF; 5: No. 2, 387-444(Jun 1973). (In French).

Various formalisms on the microscopic theory of superconductivity considered from a mathematical point of view are presented. Such considerations cover both elementary calculations and the use of more elaborate formalisms. The fundamental theoretical bases are treated: attractive electron interaction by phonon exchange (Froehlich), and bound electron states (Cooper). The practical aspects of these concepts are discussed. (FR)

28123 SUPERCONDUCTING TRANSITION TEMPERATURE OF SUPERIMPOSED METAL FILMS. Reale, C. (Centro Ricerche Pellicole Sottili, Milan). Phys. Lett.; 46A: No. 7, 461-462(11 Feb 1974).

Measurements were made of the transition temperature of a series of sandwiches composed of superimposed normal–superconducting or superconducting–superconducting films. Good agreement was obtained with the Hauser–Theuerer–Werthamer proximity-effect theory. (auth)

28124 THERMOELECTRIC POWER ABOVE THE SUPERCONDUCTING TRANSITION. Maki, K. (Tohoku Univ., Sendai). J. Low Temp. Phys.; 14: No. 5/6, 419-426(Mar 1974).

The thermoelectric power in the fluctuation region above the superconducting transition temperature T_c is studied theoretically. Use is made of the time-dependent Ginzburg–Landau (TDGL) equation due to Ebisawa and Fukuyama, which includes the correction term of the order of T/μ as well, where T is the temperature and μ is the chemical potential. It is shown that the thermoelectric power tends to zero as $(T - T_c)$ ln $[T/(T - T_c)]$ and as $(T - T_c)$ as the temperature approaches the transition temperature T_c for the two-dimensional and the one-dimensional systems, respectively. (auth)

28125 THERMODYNAMIC STABILITY OF SUPERCONDUCTING MAGNETIC STATES. Kirschner, I.; Martinas, K. (Roland Eoetvoes Univ., Budapest). J. Low Temp. Phys.; 14: No. 5/6, 427-443(Mar 1974).

The different magnetic states of superconductors are characterized by extensive and intensive parameters. The elements of the entropy matrix are determined from the derived total entropy density, which contains all possible interactions. The element of the conductivity matrix characterizing the vortex motion is also evaluated. Stability criteria for the Meissner, flux creep, and flux flow states and the value of the needed external generation are given, as are the nonequilibrium deviations, thermodynamical forces, currents and entropy productions for the different cases. The nature of the unstable flux jump state is discussed. (auth)

28126 TEMPERATURE DEPENDENCE OF H_{c2} AND K_1 IN STRONG COUPLING SUPERCONDUCTORS. Rainer, D.; Bergmann, G. (Kernforschungsanlage, Juelich, Ger.). J. Low Temp. Phys.; 14: No. 5/6, 501-519(Mar 1974).

According to the law of corresponding states, the properly scaled critical fields of a BCS superconductor are universal functions of the reduced temperature T/T_c. In realistic superconductors strong-coupling effects can cause deviations from this universal behavior. Numerical results are presented for the strong-coupling anomalies in the temperature dependence of the upper critical field H_{c2} and the Ginzburg–Landau parameter κ_1. The calculations are based on the Eliashberg theory for strong-coupling superconductors and are performed for several realistic superconductors as well as for a series of model superconductors with increasing coupling strength. It is demonstrated that the magnitude of the deviations can be estimated from the magnitude of the ratio $T_c/\langle\omega\rangle$, where $\langle\omega\rangle$ is an average phonon frequency. This rule does not apply to amorphous superconductors. The reason for this is shown to be due to the large weight of $\alpha^2F(\omega)$ at low frequencies which has been observed in these materials. (auth)

28127 MICROWAVE AND MAGNETIC FIELD EFFECTS IN SUPERCONDUCTING GRANULAR ALUMINUM FILM MICROBRIDGES. McCarthy, S. L. (State Univ. of New York, Stony Brook); Warman, J. J. Low Temp. Phys.; 14: No. 5/6, 521-528 (Mar 1974).

Anomalous effects of microwave radiation on the dc critical current of submicron (0.12 μm wide × 1.5 μm) granular aluminum bridges are observed well below the transition temperature. Application of a magnetic field strongly influences the microwave effects. (auth)

28128 FIRST-ORDER PHASE TRANSITION WITH A MOVING BOUNDARY. I. Superconducting to Normal Transition of Type I Superconductors by a Rectangular Current Pulse. Shibuya, Y. (Kyushu Univ., Fukuoka); Koga, S.; Onuki, A. J. Low Temp. Phys.; 14: No. 5/6, 549-563(Mar 1974).

The superconducting to normal transition of type-I superconductors induced by a rectangular current pulse is studied theoretically and experimentally. An exact solution for the magnetic field inside the normal part of the specimen is obtained and the time when the radius of the S–N boundary becomes the radius r_s of the London model for the case of steady state is compared with Pippard's result and that of Rothen and Bestgen. Experimental results are discussed in relation to these calculations. (auth)

28129 A-15 PHASES: OCCURRENCE, GELLER RADII, AND ELECTRONIC STRUCTURE. Johnson, G. R.; Douglass, D. H. (Univ. of Rochester, NY). J. Low Temp. Phys.; 14: No. 5/6, 565-573(Mar 1974).

Reported A-15 phases are tabulated using a comparison between measured and predicted lattice parameters as a criterion. An enlarged set of Geller radii is calculated, and trends in these are used to discuss electronic features of these compounds. The small variation of superconducting T_c among some compounds related to Nb_3Sn is explained in terms of constant electronic features deduced from the Geller radii. (auth)

28130 TYPE II SUPERCONDUCTIVITY WITH DISPERSED INTERMETALLIDE PHASES. Pan, V. M.; Veletskii, Yu. I. (Inst. of Metal Physics, Kiev). Metallofizika; No. 45, 81-84(1973). (In Russian).

V–Ga and Nb–Al alloys were studied in the range of compositions where aging deformed supersaturated solid solutions with a bcc lattice may occur and the separated phase is the more superconducting compound with a β–tungsten type crystal structure. Critical temperatures and critical current densities were measured. Results are compared with data from a transmission electron microscope. It was shown that proper selection of the alloy composition and thermomechanical processing regime may result in dislocation cell structures in which dispersed particles of the separated intermetallide phase are deposited at the cell boundaries. The alloy then is plastic and critical temperatures approach values for massive compounds, and the critical current density may reach 3.5×10^5 A/cm^2. (tr-auth)

28131 ANOMALOUS PAIR CURRENTS IN JOSEPHSON JUNCTION. Simanek, E. (Univ. of California, Riverside). Phys. Lett.; 47A: No. 2, 109-110(11 Mar 1974).

A mechanism for the anomalous peak in the I–V characteristics of the Josephson junction is proposed which is due to the creation of quasiparticle pairs by the self-induced ac voltage. (auth)

28132 OBSERVATION OF FLUX LINE PINNING IN SUPERCONDUCTING FOILS. Herring, C. P. (Oxford Univ.). Phys. Lett.; 47A: No. 2, 105-106(11 Mar 1974).

Pinning of individual flux lines by crystal defects in niobium is studied by transmission electron microscopy of decorated thin foils. (auth)

28133 INTERPHASE SURFACE ENERGY OF SUPERCONDUCTING NIOBIUM. Herring, C. P. (Oxford Univ.). Phys. Lett.; 47A: No. 2, 103-104(11 Mar 1974).

The intermediate-mixed state laminar domain structure has been decorated on high purity dished niobium discs at 4.2°K. The Landau–Lifshitz–Sharvin theory is tested and used and the interphase surface energy is estimated at $(3.7 \pm 0.9) \times 10^{-3}$ ergs cm^{-2}. (auth)

28134 SUPERCONDUCTING TRANSITION TEMPERATURES OF VAPOR QUENCHED BERYLLIUM. Granqvist, C. G.; Claeson, T. (Chalmers Univ. of Tech., Goteborg). Phys. Lett.; 47A: No. 2, 97-98(11 Mar 1974).

T_c for vapor quenched Be is depressed in thin films. In the limit of infinite thickness $T_c = 9.95 \pm 0.06$ K was measured. (auth)

28135 a. c. JOSEPHSON EFFECT IN THE PHASE OPERATOR FORMALISM. Viano, M.; Rocca, F. (Univ., Nice). Nuovo Cim.; 20B: No. 1, 133-143(11 Mar 1974).

A quantum phase operator formalism is developed for system with an infinity of degrees of freedom and some condensation properties. A microscopic formulation of the ac Josephson effect in superfluid helium is presented in this formalism. In particular a hypothesis is formulated on the existence of stable level differences between the two superfluid systems which are submultiples of a basic unit. (auth)

28136 SPECIFIC PHASE TRANSITION IN SUPERCONDUCTORS OF SMALL K. Kirschner, I. (Roland Eoetvoes Univ., Budapest). Phys. Lett.; 47A: No. 2, 139-140(11 Mar 1974).

A specific phase transition at which the superconductivity changes its order due to increasing alloy concentration has been observed. The values of the critical temperature, of the critical fields, of the GL parameter and the critical concentration have been determined. (auth)

28137 SUPERCONDUCTIVITY IN NEW A-15 NIOBIUM ALLOYS. Johnson, G. R.; Douglass, D. H. (Univ. of Rochester, NY). J. Low Temp. Phys.; 14: No. 5/6, 575-595(Mar 1974).

A number of previously unreported A-15 Nb alloys have been studied, using samples prepared by dual target sputtering. T_c was measured resistively and structure determined by x-ray diffraction. Samples were "chemically" analyzed by anodization. New alloys include A-15 Nb_3Si and pseudobinary derivatives, as well as some derivatives of "Nb_3P." T_c and the A-15 lattice parameter were surveyed for these, and for previously studied alloys related to Nb_3Al, Nb_3Ga, and Nb_3Ge. The "chemical" variation of T_c was slight, except near pure Nb_3Si and for alloys based upon "Nb_3P," where the samples show considerable disorder. Maxima in T_c occur for the alloys $Nb_3Al_{0.7}Ge_{0.3}$ and $Nb_3Al_{0.8}Ga_{0.2}$. The first is well known; trends measured here indicate that the second may be equally high. It is proposed that the dominant factor for T_c in this group of alloys is the state of order achieved in the samples. No evidence was seen to associate enhanced T_c with A-15 phase boundaries. (auth)

Equipment and Devices

Refer also to abstracts 27378 and 28142.

28138 (AD-766503-7) DETECTION AND EMISSION OF RADIATION BY ARRAYS OF JUNCTIONS. Clark, T. D. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). 1 Sep 1973. Contract N00014-67-A-0077-0016. 47p. NTIS $3.00.

The interaction of small regular planar arrays of point contact Josephson junctions with an electromagnetic field, either self-generated or externally applied, is discussed. The experimental data obtained in terms of a single frequency, "super-radiant" state for the point contact array are reviewed. (GRA)

28139 (AD-768335-2-GA) NOVEL PARAMETRIC NEGATIVE RESISTANCE EFFECT IN JOSEPHSON JUNCTIONS. Report for 1 January 1973–30 June 1973. Kanter, H. (Aerospace Corp., El Segundo, Calif. (USA)). 29 Oct 1973. Contract F04701-73-C-0074. 18p. (SAMSO-TR-73-302). NTIS $2.75.

The negative resistance effect recently predicted for current controlled highly damped Josephson junctions is experimentally demonstrated at a frequency of 9 GHz. Characteristically, the pump (or Josephson) frequency is smaller than the amplified one and the pump mechanism is effective over a broad range of frequencies in contrast to the conventional parametric negative resistance effect where the pump frequency exceeds that of signal and idler and where the frequency of operation is limited to a narrow range. The broadband feature renders operation uncritical to tuning and bias voltage fluctuations. The fact that the junction is the element of lowest impedance in the circuit alleviates to a degree the matching problem generally encountered with Josephson contacts. (auth)

28140 (JINR-P13-7489) CHOICE OF OPTIMAL PARAMETERS FOR THE SUPERCONDUCTIVE QUANTUM MAGNETOMETER. Vasiliev, B. V.; Ivanenko, A. I.; Trofimov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The problem of choosing the optimal coupling coefficient and optimal working frequency for superconductive quantum magnetometer is considered. The present experimental signal-noise dependence confirms the drawn conclusions. (auth)

28141 ENERGY GAP, MICROWAVE-ASSISTED TUNNELING, AND JOSEPHSON STEPS IN THIN-FILM WEAK LINKS AT 63 AND 302 GHz. Kofoed, B.; Saermark, K. (Physics Laboratory I, The Technical University of Denmark, DK-2800 Lyngby, Denmark). Phys. Rev. Lett. 31: No. 18, 1124-1126 (29 Oct 1973).

We present experimental evidence for the occurrence of energy-gap structure and microwave-assisted tunneling in the IV curves for superconducting thin-film weak links. From measurements of the power and the temperature dependence of the Josephson steps we argue that also the Riedel peak is observable in weak links. (auth)

28142 ADVANCES IN CRYOGENIC ENGINEERING. Volume 18. Proceedings of the 1972 Conference, Boulder, Colorado, August 9–11, 1972. Timmerhaus, K. D. (ed.). Cryogenic Engineering Conference Publication. New York; Plenum Publishing Corporation (1973). 543p. (CONF-720803-). $47.50.

Sixty-two papers were presented at the conference. A separate abstract was prepared for each of sixteen papers. The remaining papers are considered not in the scope of NSA. (JRD)

For abstracts of individual papers see: 27232, 27378, 27463, 28092, 28093, 28113, 28143–28151, and 28820.

28143 REFRIGERATION FOR THE LIVERMORE SUPERCONDUCTING LEVITRON. Duffy, T. J.; Taylor, C. E. (Univ. of California, Livermore). Advan. Cryog. Eng.; 18: 360-367 (1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

The following subjects are covered: ring support, cooling, and ring charging; the cold assembly; internal plumbing and helium circulation, refrigerator and cooldown; and nitrogen temperature refrigeration. (MHR)

28144 MIT–EEI SUPERCONDUCTING SYNCHRONOUS MACHINE. Thullen, P.; Bejan, A.; Gamble, B.; Kirtley, J. L. Jr.; Smith, J. L. Jr. (Massachusetts Inst. of Tech., Cambridge). Advan. Cryog. Eng.; 18: 372-381(1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

The first experimental machine was constructed to demonstrate the feasibility of using superconductors for the rotating field winding of a synchronous machine. A preliminary design study has been carried out for large synchronous machines with superconducting field windings. The second machine will test features which may be suitable for application to machines of the 1000-MVA class. This machine is described in some detail. (9 figures) (MHR)

28145 60-IN.-DIAMETER, LEVITATED SUPERCONDUCTING COIL THERMALLY SHIELDED BY LEAD. Willard, J. W.; Martin, G. D. (Princeton Univ., NJ). Advan. Cryog. Eng.; 18: 382-387(1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

A 60-in.-diameter superconducting coil is levitated in the FM-1 machine at the Plasma Physics Laboratory, Princeton University. A 60-in.-major-, 7.125-in.-minor diameter dewar thermally shielded by lead has been constructed. This dewar increases the isochoric operating time of the superconducting coil from 1.4 to 11.5 hr. The major physical data pertaining to this coil and dewar are tabulated. The coil winding, coil, dewar description and assembly, and performance analysis are discussed. (7 figures) (MHR)

28146 VIBRATION SIMULATION OF A SPACE PROBE MODEL SUPERCONDUCTING ENERGY STORAGE COIL. Rogers, J. D. (Los Alamos Scientific Lab., NM). Advan. Cryog. Eng.; 18: 388-393(1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

Model experiments of the final coil were conducted to observe critical current behavior, magnet charging characteristics, persistent mode operation and field coupling efficiency with an explosive generator. The experiment indicates with the limitations of the model that the superconductor and winding techniques used have a high probability of successful application in the fabrication of higher-energy storage coils subject to mechanical vibrational forces. (MHR)

28147 FIVE-MVA SUPERCONDUCTING GENERATOR DEVELOPMENT. Mole, C. J.; Fagan, T. J.; Haller, H. E. III; Litz, D. C.; Patterson, A. (Westinghouse Electric Corp., Pittsburgh). Advan. Cryog. Eng.; 18: 394-399(1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

A 5-MVA, 60-Hz, 4160-V, 695-A superconducting synchronous generator was designed, built, and tested. The research program as well as the overall machine design and performance are described. (MHR)

28148 CONDUCTORS FOR SUPERCONDUCTING ELECTRICAL MACHINES. Deis, D. W.; Reynolds, W. T. (Westinghouse Research Labs., Pittsburgh). Advan. Cryog. Eng.; 18: 400-406 (1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

The following subjects are discussed: machine and superconductor characteristics, conductor requirements, and conductor development status. (MHR)

28149 THERMAL CONDUCTIVITY OF BRAIDED SUPERCONDUCTOR SYSTEMS. DeVito, B.; Jensen, J. E. (Brookhaven National Lab., Upton, NY). Advan. Cryog. Eng.; 18: 407-415(1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

The thermal conductivity of braided superconductors in several epoxy-supported coil forms was measured. The apparent or overall thermal conductivity of four systems was measured parallel and perpendicular to the width of the braided conductor. The experimental apparatus and procedure are described and the experimental thermal conductivity presented for both directions at various temperatures. A mathematical model using the solid conduction equation is presented for comparison. (MHR)

28150 FIELD AND CURRENT MEASUREMENTS AND CALCULATIONS IN A SUPERCONDUCTING TAPE-WOUND MAGNET. Donaldson, G. W. (Univ. of New South Wales, Sydney). Advan. Cryog. Eng.; 18: 416-422(1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

In flux-jump investigations the field and current should be known accurately inside the superconductors. This presentation describes how these may be calculated. The initial comparison of calculated and measured values of trapped field suggests that further analysis will be needed before good agreement is reached. The form of the field plots indicates that the pattern determined for the circulating currents is correct. (MHR)

28151 LOW-HEAT-LEAK, TEMPERATURE-STABILIZED SUPPORT. Heim, J. R.; Fast, R. W. (National Accelerator Lab., Batavia, IL). Advan. Cryog. Eng.; 18: 494-496(1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

The ideal low-temperature structural support member would conduct negligible amounts of heat to the cold mass, exhibit no thermal distortion when cooled, and have good load-carrying capability. The support member described here which approaches this ideal can be constructed using normal shop practice and common laboratory equipment. The test specimen shown was sized to carry a 1000-kg axial load at 4 K with a calculated heat leak which would contribute less than 0.016 liquid liters per hour to the cryostat helium boiloff and no thermal contraction when cooled down. The top end of the column is attached to a liquid helium chamber and the bottom end is attached to the vacuum jacket wall at room temperature. The joint between the intermediate and outer tubes is thermally sinked to a liquid nitrogen radiation shield at 77°K. For a superconducting magnet coil support a combination of inexpensive materials may be chosen which satisfies the thermal contraction criteria and also has low heat conduction. (MHR)

28152 SUPERCONDUCTING MAGNETIC SYSTEMS. Sychev, V. V.; Zenkevich, V. B. (Inst. of High Temperatures, Moscow). At. Energy Rev.; 11: No. 4, 711-791(Dec 1973).

The current status of superconducting magnetic systems is described, and the possibilities and prospects are examined. Most of the information used was published after 1970, but in some cases earlier references are quoted. Research and development work on new internally stabilized superconducting materials is reviewed. The possibilities of developing efficient internally stabilized conductors based on intermetallic compounds in the near future are analyzed. A discussion follows of the applications of superconducting magnets of various types in high-energy physics (charged particle detectors, deflecting and focusing magnets and accelerator magnets), plasma physics (magnetic plasma confinement systems, including current proposals regarding the use of superconducting devices in future thermonuclear reactors), energy and transport (magnets for MHD generators, for providing magnetic fields for electric machines, magnetically suspended trains) etc. Both magnets operating on direct current and pulsed superconducting magnetic systems, in particular inductive energy storage devices, are discussed. The variety of technical solutions adopted during the development of superconducting magnetic systems is described, as are the design trends to which they have given rise. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 28337 and 28343.

28153 (JINR-P3-7809) WAVE PROPERTIES OF ULTRACOLD NEUTRONS. Frank, I. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The analogy between the indexes of refraction of neutron and light waves is discussed. The influence of the effective field on the neutron absorption coefficient is considered. It is shown that for the case of neutron waves the imaginary part of this field must not be neglected. Proper account of the effective field, probably, will enable one to reveal experimentally the found anomaly in the time of storage of ultracold neutrons. (auth)

28154 (JINR-P3-7810) ABSORPTION AND REFLECTION OF ULTRACOLD NEUTRONS. Frank, I. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.25.

The peculiarities of the complex index of refraction $n_\lambda = n'_\lambda + in''_\lambda$ are considered. A notion about the neutron velocity in matter is introduced for ultracold neutrons ($V_\lambda < V_0$) and for very cold neutrons ($V_\lambda > V_0$). The problem is considered about reflection and passage of neutron waves in matter and about the ultracold neutron absorption. The hypothesis is suggested that explains the anomaly in the time of storage of ultracold neutrons. (auth)

28155 HIGH FREQUENCY BEHAVIOR OF THE NEUTRON-SCATTERING FUNCTION. Kleban, P. (Institut Laue-Langevin, Grenoble, France). Physica; 70: No. 1, 105-124(15 Nov 1973).

It is shown that the high frequency behavior of the neutron-scattering function due to collisions in classical systems depends only on the interparticle potential and the pair correlation function at small distances. The calculation of the scattering function reduces to the solution of a two-body problem which is then averaged over a Maxwellian distribution of initial velocities and a distribution of initial positions given by the pair correlation function for the full system. Good agreement with recent measurements on liquid argon is obtained. (auth)

28156 HEATING ULTRACOLD NEUTRONS BY ACOUSTIC OSCILLATIONS OF THE TRAP WALLS. Gerasimov, A. S.; Ignatovich, V. K.; Kazarnovskii, M. V. Kratk. Soobshch. Fiz.; No. 8, 56-61(Aug 1973). (In Russian).

The heating of ultracold neutrons by acoustic oscillation of the trap walls is theoretically examined. The probability of changing the neutron energy during collisions with oscillating walls are calculated classically and quantum mechanically. Kinetic equations describing the dependence on residence of the total number of neutrons in the trap are derived and solved. (tr-auth)

28157 KINETIC THEORY OF COLLISIONAL LINE NARROWING IN PRESSURIZED HYDROGEN GAS. Chen, S. H.; Lefevre, Y.; Yip, S. (Massachusetts Inst. of Tech., Cambridge). AT(11-1)-3352. Phys. Rev., A; 8: No. 6, 3163-3173(Dec 1973).

The incoherent quasielastic scattering of thermal neutrons from hydrogen gas is measured at 85°K and various pressures up to 140 atm. The observed Van Hove self-correlation function (or the self-part of the dynamic structure factor) shows a narrowing effect as the ratio of the observational wave length to the collisional mean free path increases. The resulting line shape and linewidths are analyzed using an appropriate kinetic equation. The theoretical prediction agrees with experiment when the only parameter in the theory, namely, the self-diffusion coefficient, is properly calculated in the Enskog approximation. It is demonstrated experimentally that the linearized Boltzmann equation gives an accurate description of the dynamics of the single-particle motion at moderately high density and in the range of wave vectors and frequencies comparable to inverse collision mean free paths and collision frequencies of the molecules. (auth)

28158 ESTIMATION OF THE EFFECT OF SELF-SHIELDING IN SUBSTANCES WITH A HIGH NEUTRON CAPTURE CROSS-SECTION (H_3BO_3, B_2O_3, B_4C). Yankovskaya, T. A.; Lobanov, E. M.; Usmanova, M. M. (Inst. of Nuclear Physics, Tashkent). Zh. Anal. Khim.; 28: No. 12, 2311-2316(Dec 1973). (In Russian).

An experimental method is suggested for estimating the effect of self-shielding by process modeling on boron-bearing compounds. The shielding coefficients were determined for some elements in the irradiation of samples of 0.5-0.8 g in a thermal and vertical channel of VVR-S reactor. The dependence of K_{exp} on the sample weight and boron concentration was elucidated. Optimal sample weights for which the shielding coefficient does not exceed 2.0 were determined. (1 figure, 3 tables) (auth)

28159 STRUCTURAL PROPERTIES AND FINITE RANGE ELEMENTARY SOLUTIONS OF THE LINEAR BOLTZMANN EQUATION. Syros, C. (European Atomic Energy Community, Brussels). Acad. Roy. Belg., Cl. Sci., Mem., Collect. 8; 59: No. 6, 500-518(1973).

The natural solutions of the time- and energy-independent linear Boltzmann equation with isotropic scattering were found on $A \otimes B^\delta$, where A is the interval [a,b] a,b > 0 and $B^\delta = [-1,0[\cup]0,1]$. These functions are regular everywhere on $A \otimes B^\delta$, and they satisfy homogeneous or inhomogeneous boundary conditions. The solutions become uniformly continuous functions on $A \otimes B$ and have bounded derivatives of any order if the convention for taking limits $\lim_{x\to a} \lim_{r\to 0} \psi(x,z)$ is used. The construction of the solutions is based on a number of structural properties established by corresponding new theorems. They exhibit invariance properties with respect to translation, parity and scaling transformations. (auth)

28160 CALCULATION OF THE RELATIVE YIELD OF ULTRACOLD NEUTRONS OBTAINED BY MEANS OF A ROTATING FLAT NEUTRON MIRROR. Kashukeev, N. T.; Mircheva, D. S.; Yaneva, N. B. (Inst. of Nuclear Research and Nuclear Energy, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 11, 1449-1451(1973). (In Russian).

The dependence of the yield of ultracold neutrons in a mechanical generator on the angular momentum of the rotating system is determined. The yield is calculated with and without geometric limitations. (JSR)

28161 FUNCTIONALS FOR FREE BOUNDARIES AND DISCONTINUOUS TRIAL FUNCTIONS IN DIFFUSION THEORY. Breitenhuber, L.; Maschek, W. (Technische Hochschule, Graz). Atomkernenergie; 22: No. 1, 3-5(Sep 1973).

New functionals of first and second order are discussed admitting free boundaries and discontinuous trial functions. This gives a greater flexibility and therefore a better approximation. The adaptation of the functionals is performed by divergence terms and surface integrals. (GE)

28162 UNIQUENESS THEOREM ASSOCIATED WITH A GENERAL PHYSICS PROBLEM. Murray, J. C. (Univ. of Southampton, Eng.). Phys. Lett.; 47A: No. 1, 59-60(25 Feb 1974).

A uniqueness theorem is established for a linear initial-boundary value problem associated with the equations of telegraphy, neutron diffusion, heat conduction, classical wave-propagation, wave propagation in a porous medium, together with the Klein-Gordon and Schrödinger equations. (auth)

28163 PRODUCTION, STORAGE, AND POLARIZATION OF ULTRACOLD NEUTRONS. Egorov, A. I.; Lobashev, V. M.; Nazarenko, V. A.; Porsev, G. D.; Serebrov, A. P. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 19: No. 2, 300-310 (Feb 1974). (In Russian).

Experimental results on yield of ultracold neutrons (UCN) in various types of neutron-guides are presented. The results are considered on storage of UCN in nickel and glass traps as well as in traps with heating. Data on polarization of UCN resulting from transmission of UCN through thin ferromagnetic films are presented. (auth)

Nuclear Properties and Reactions, A ≤ 5

28164 (INIS-mf-1010) COINCIDENCE STUDY OF SOME FEW-NUCLEON REACTIONS. Wielinga, B. J. (Amsterdam Univ. (Netherlands); Stichting voor Fundamenteel Onderzoek der Materie, Utrecht (Netherlands)). 5 Jul 1972. 133p. INIS.

The break-up of 26.5-MeV deuterons and 69-MeV ^{3}He-particles on protons was investigated in a kinematically complete way, using the multidetector coincidence system BOL at the Institute for Nuclear Physics Research (IKO). The data at particular combinations of angles were analyzed using several simple models like the Watson-Migdal model and the impulse approximation. The experimental data were also studied in a Dalitz-type representation as a function of several kinematical variables e.g. relative energies and momentum transfer. Angular correlations of two nucleons in the recoil-center-of-mass system, which are expected to be isotropic when the main contribution comes from the $l = 0$ relative motion, did show only isotropy for nucleon-nucleon rela-

tive energies smaller than about 2 MeV. In the case of the p + ^{3}He → d + p + p reaction, even at low proton-proton relative energies, deviations from isotropy were found. This indicates that the reaction p + ^{3}He → d + (pp) does not proceed purely sequential via the $^1S_0$ proton-proton state. Angular distributions for the p + d → p + (pn) reactions were obtained for several regions of proton-neutron relative energy. Angular distributions for the p + ^{3}He → d + (pp) reaction show a diffraction pattern for low p-p relative energies, which disappears when proton-proton relative energies larger than 4 MeV are selected. A model assuming incoherent neutron and proton pickup contributions gives qualitative agreement with the experimental distributions. The integrated four-body break-up data on the p + ^{3}He → p + p + p + n reaction did not reveal a significant enhancement near nucleon-nucleon final state interaction conditions. The excitation spectra for the p-d and p-p-n systems did not consistently show peaks with a width smaller than 2 MeV which could correspond to excited states in the A = 3 system. Broad structures in the p-d relative-energy spectra were shown to be mainly due to two-body processes like QFS and FSI. (auth)

28165 (INIS-mf-1023) THREE-BODY NUCLEAR PROBLEM. Wilner, E. (Sao Paulo Univ. (Brazil). Instituto de Fisica). 1972. 72p. (In Portuguese). INIS.

Thesis.

The three body nuclear problem is analyzed by a method based on the symmetry properties of the system Hamiltonian, in a 6-dimension space. For central potentials, in this space, the invariant group is the R(6). Assuming the spatial part of the ground state function as completely symmetric, by coordinate permutation, various types of central potentials are studied, and the form factors and radius are calculated, as well as the ^{3}He Coulomb energy, using as input the experimental values of the binding energies. The diffractive character of the ^{3}He charge form factor is emphasized. There is significant agreement in comparing the results here obtained with the experimental data, even with the simplified treatment, mainly for an harmonic oscillator potential with a repulsive core of the type $\gamma/r^2\ e^{-\mu r^3}$. Possibilities for extention of the problem are indicated, mainly in applying the Simonov hyperspherical harmonics method to the three body problem. (auth)

28166 (KFKI-73-68) RECOMMENDED VALUES OF (n,2n) CROSS SECTIONS. Jeki, L. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1973. 12p. Dep. NTIS (U.S. Sales Only) $3.00.

The cross section data of /n,2n/ reactions predicted by different empirical formulas are compared with each other and with the experimental data. The predictions from the Adám-Jéki formula with refitted parameters show an improved agreement with the measured cross section values. (auth)

28167 NEW METHOD FOR EVALUATING THE DENSITY MATRIX AND ITS APPLICATION TO THE GROUND STATE FORM FACTORS OF ^{4}He AND ^{16}O. Fink, M. (Ruhr-Univ., Bochum, Ger.). Nucl. Phys., A221: No. 1, 163-172(1974).

The form factors of ^{4}He and ^{16}O are calculated using wave functions given by solutions of a generalized Hartree–Fock equation. No free parameters exist in the theory except the parameters of various phenomenological nucleon–nucleon potentials. The c.m. motion is treated exactly in the framework of a many body theory. The results strongly depend on the nucleon–nucleon potentials. (auth)

28168 COMPARISON OF THE ^{3}He(p,2p)d AND ^{3}He(p,pd)p REACTIONS. Cowley, A. A.; Roos, P. G.; Pugh, H. G.; Cheng, V. K. C.; Woody, R. III. (Univ. of Maryland, College Park). Nucl. Phys., A220: No. 3, 429-437(1974).

The ^{3}He(p,2p)d and ^{3}He(p,pd)p reactions were compared at three bombarding energies from 65 to 100 MeV. A comparison of plane wave impulse approximation calculations to the experimental data indicates that multiple scattering effects are large and energy dependent but that they primarily produce a uniform reduction in cross section. Although multiple scattering effects are large the ratio of the cross sections for the two reactions is in agreement with that predicted by the impulse approximation. (auth)

28169 INTEGRAL EQUATION APPROACH TO FOUR-NUCLEON BOUND STATES. Narodetskii, I. M. (Inst. for Theoretical and Experimental Physics, Moscow). Nucl. Phys., A221: No. 1, 191-210(1974).

Within the framework of the Yakubovsky four-body equations the 0^+ bound states of ^{4}He are determined. The two-particle interactions used are of the separable Yamaguchi type and include spin-dependent forces. The problem is reduced to the solution of four coupled integral equations in two variables. The separable approximation of the kernels makes it possible to reduce the problem to a set of single variable integral equations. The separable approximation method employed is based on the Hilbert-Schmidt expansion applied to the kernels of four-body equations. The ground state energy of ^{4}He is found to be −45.73 MeV, the excited 0^+ level lies at −11.69 MeV. In conclusion the accuracy of various approximate methods in the four-nucleon problem is discussed. (auth)

28170 ERROR OPERATOR AND ITS EIGENVECTORS IN ELECTRON SCATTERING. Hetherington, J. H.; Borysowicz, J. (Michigan State Univ., East Lansing). Nucl. Phys., A219: No. 2, 221-231(1974).

A formal analysis is made of the error in the nuclear charge density when determined from electron scattering. The error statement is made by introducing error functions describing asymptotic behavior of the density and the form factor. It is possible to make a complete error statement using the above functions, so that there is no need to use a truncated basis. Consequently, the analysis is basis independent. Because an error operator was introduced which has one part analogous to a potential (because it can be written simply in coordinate space) and another part which might be made analogous to the kinetic energy (because it is simply written in momentum space) the analogy of the error operator to the Hamiltonian was made. It was found that results of previous work remain valid and the conclusions are unaltered but the present procedure lends greater mathematical rigor. (auth)

28171 PHASE-SHIFT ANALYSIS OF ELASTIC PROTON–DEUTERON SCATTERING CROSS SECTIONS AND ^{3}He EXCITED STATES. Arvieux, J. (Univ. of California, Berkeley). Nucl. Phys.; A221: No. 2, 253-268(1974).

A phase-shift analysis of recent experimental data on elastic proton–deuteron scattering and reaction cross sections was performed for laboratory energies from 1 to 46.3 MeV. Phase shifts up to L = 8 calculated by Faddeev-equation techniques were included in the analysis. A new set of p–d scattering lengths is given which rules out the possibility of a pole term in the effective range expansion of the doublet $^2S_{\frac{1}{2}}$ phase. The Argand plot of the ^4P wave is shown to be consistent with a broad resonance in ^{3}He centered around an excitation energy of 14 MeV. This resonance is discussed in the light of preceding experimental and phase-shift-analysis results. (8 figures, 2 tables) (auth)

28172 TENSOR ANALYZING POWER A_{zz} AT $\theta = 0^0$ FOR THE ^{3}He($\vec{d}$,p)^{4}He REACTION. Trainor, T. A. (Univ. of North Carolina, Chapel Hill); Clegg, T. B.; Lisowski, P. W. Nucl. Phys.; A220: No. 3, 533-540(1974).

The tensor analyzing power A_{zz} was measured for the ^{3}He($\vec{d}$,p)-^{4}He reaction at $\theta = 0^0$ over an incident deuteron energy range E_d = 6.6 to 5.8 MeV in steps of 0.5 MeV. The present results agree with and extend the previous measurements of Grüebler et al. The present results indicate that this reaction is a very good tensor analyzer for polarized deuteron beams with energies up to 15.8 MeV. (auth)

28173 VARIATIONAL CALCULATIONS ON THE THREE-BODY SCATTERING PROBLEM. Schwager, J. (Univ., Tuebingen, Ger.). Nucl. Phys.; A221: 371-380(1974).

An extended resonating-group method is used to calculate the elastic scattering amplitudes (up to L = 2) for a system of three identical bosons interacting through local Yukawa potentials. The results are compared with approximate solutions of the Faddeev equations. (4 figures) (auth)

28174 ^{3}H(p,n)^{3}He REACTION WITH POLARIZED PROTONS FROM THRESHOLD TO 2.9 MeV. Brown, L. (Carnegie Institution of Washington, DC); Rohrer, U. Nucl. Phys.; A221: No. 2, 325-332(1974).

A polarized beam was used to measure angular distributions of the analyzing power of the ^{3}He($\vec{p}$,n)^{3}He reaction at 9 energies from 1.30 to 2.90 MeV. The data were measured typically to an accuracy of 0.02 with a target 25 keV thick at 2 MeV bombarding energy. The analyzing power can be fitted with associated Legendre polynomials. The coefficient of P_1^1 is small, near zero at the upper and lower energies and negative in between; the coefficient of P_2^1 is much larger and positive, rising to a maximum at 2.2 MeV. Comparison of the analyzing power, A, with earlier data for the neutron polarization, P, induced with unpolarized protons shows the coefficients of P_1^1 to be equal and those of P_2^1 to have a similar energy dependence but with larger values for A than for P. Theoretical treatment elsewhere of the inequality of P and A infers that transitions between $^3P_2$ and $^3F_2$ are responsible. Polarization contour maps are given. (5 figures, 1 table) (auth)

28175 MUON CAPTURE IN GASEOUS DEUTERIUM. Bertin, A.; Vitale, A. (Istitudo di Fisica dell'Università di Bologna, and Istituto Nazionale di Fisica Nucleare, Sezione di Bologna, Bologna, Italy); Placci, A.; Zavattini, E. Phys. Rev. D 8: No. 11, 3774-3793 (1 Dec 1973).

We report the results of an experiment performed to measure the muon nuclear capture rate by free deuterons. The muons were slowed down in ultra-pure gaseous hydrogen at 7.6 atm and 293°K, containing 5% of deuterium. A special target was used, in which a system of gas proportional counters, working with the (H_2 + D_2) gaseous mixture itself, was operating. Neutrons from the capture reactions were detected using liquid scintillation counters, and the gamma-ray's background was eliminated by pulse-shape discrimination. The experimental result is $\Lambda_{exp} = (445 \pm 60)\ sec^{-1}$, which is consistent with muon-electron universality and with the assumption that the nuclear capture proceeds from the doublet spin state of the μd muonic atoms. Combining the present experimental value with a previous result obtained with a liquid-hydrogen deuterated target, one obtains a ratio between the axial-vector and vector coupling constants given by $g_{A,p}/g_{V,p} = -1.35 \pm 0.1$. (auth)

28176 MEASUREMENT OF NEUTRON-DEUTERON POLARIZATION AT 35 MeV. Zamudio-Cristi, J.; Bonner, B. E.; Brady, F. P.; Jungerman, J. A.; Wang, J. (Crocker Nuclear Laboratory and Dept. of Physics, University of California, Davis). Phys. Rev. Lett. 31: No. 16, 1009-1012 (15 Oct 1973).

The neutron polarization asymmetry in neutron-deuteron scattering has been measured from 44.5° to 160° (c.m.) neutron angle. The results display quantitatively the same structure as proton-deuteron polarization data, but discrepancies appear for angles corresponding to those near the minimum of the differential cross section. In this region the polarization is considerably more negative than in the proton-deuteron case, and both are more negative than current theoretical predictions. (auth)

28177 APPLICATION OF THE ACCELERATED CONVERGENCE EXPANSION TO A PHASE SHIFT ANALYSIS OF THE PLASTIC $\pi^{\pm}$ ^{4}He SCATTERING. Dumbrais, O. V.; Nichitiu, F.; Scherbakov, Yu. A. (Joint Inst. for Nuclear Research, USSR). Rev. Roum. Phys.; 18: No. 10, 1249-1255(1973).

A phase shift analysis of the elastic $\pi^{\pm}$ ^{4}He scattering data in the range 24 to 180 MeV kinetic energy was carried out by means of the accelerated convergence expansion. The results of this analysis and of the conventional analysis are compared. The significance of the higher partial waves is discussed. (auth)

28178 GIANT RESONANCES AND POLARIZATION EFFECTS. Hamamoto, I. (Technical Univ., Munich). Kakuriken Kenkyu Hokoku; 5: 205-212(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

In order to investigate the properties of high lying excitation modes for giant resonance and polarization effects, the Bohr and Mottelson model is used. Excitation energies and oscillator strengths of certain excitation modes are found. Lead-208 is discussed. (JFP)

28179 STUDY OF THE GIANT E1 RESONANCE WITH POLARIZED AND UNPOLARIZED (p,γ) REACTIONS. Hanna, S. S. (Stanford Univ., CA). Kakuriken Kenkyu Hokoku; 5: 453-480 (1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

Studies of the giant E1 resonance in ^{4}He, ^{12}C, ^{16}O and ^{90}Zr with the polarized ($\vec{p}$,γ) reaction are reported and discussed. It is shown that, with the exception of ^{12}C, the polarized and unpolarized measurements fix the amplitudes and relative phases of the proton partial waves. In addition to predicting the distribution of strength any successful theory of the GDR should account for these configurations. (auth)

28180 COINCIDENCE STUDY OF THE REACTION ^{3}He(e,pd)e′ REACTION. Shin, Y. M.; Skopik, D. M.; Pla, C. (Univ. of Saskatchewan, Saskatoon). Kakuriken Kenkyu Hokoku; 5: 481-489 (1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The existence and nature of the excited state at about 20.5 MeV are investigated, and the sensitivity of the transition charge densities on the trinucleon wave functions was studied for helium 3 (e,pd) reactions at 100 MeV. No evidence was found for an excited state in the coincidence cross sections measured at photon points. (JFP)

28181 EFFECT OF ISOBAR CONFIGURATIONS ON THE PHOTODISINTEGRATION OF THE DEUTERON. Arenhoevel, H.; Miller, H. G. (Max-Planck-Institut fuer Chemie, Mainz). Kakuriken Kenkyu Hokoku; 5: 491-498(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

Typical radial wave functions and total cross sections from 10 to 120 MeV are given for deuteron photodisintegration to study the effect of introducing isobar configurations into the deuteron. (JFP)

28182 POLARIZATION IN NEUTRON-PROTON SCATTERING AT 16.4 AND 21.6 MeV. Jones, D. T. L.; Brooks, F. D. (Univ. of Cape Town, Rondebosch, South Africa). Nucl. Phys.; A222: No. 1, 79-92(1974).

The polarization in neutron-proton scattering was studied by using polarized neutron beams obtained from the ^{3}H(d, n) reaction, scattering these beams in monocrystalline anthracene scintillators, and observing the asymmetry of the associated recoil protons. The technique used is a new one, which utilizes the directional dependence of the scintillation properties in order to determine the left-right asymmetry of the proton recoils within the scintillation crystal. The measurements led to polarization values at neutron c.m. scattering angles from 90° to 150° at 16.4 MeV and from 50° to 170° at 21.6 MeV, in 20° steps in both cases. The $\Delta^R_{1,5}$ and $\Delta^R_{1,5}$ spin-orbit splitting phase parameters derived from the measurements are 0.52° ± 0.06° and 0.02° ± 0.05°, respectively, at 16.4 MeV; and 0.93° ± 0.04° and 0.11° ± 0.02°, respectively, at 21.6 MeV. The data are compared with the predictions of the Yale-Buffalo and Livermore phase parameter fits. (8 figures, 4 tables) (auth)

28183 NUCLEAR PHOTOEFFECT ON HELIUM ISOTOPES. Gorbunov, A. N. Tr. Fiz. Inst., Akad. Nauk SSSR; 71: 3-119 (1973). (In Russian).

Experimental results on the photonuclear processes on ^{3}He and ^{4}He at photon energies up to 170 MeV are reported. A comparison is made of the experimental results and the theoretical predictions. The analysis of the experimental results obtained makes it possible to draw some conclusions on the mechanism of the photonuclear process, the nuclear forces, wave functions of the ground state, and the condition of the discontinuous spectra of the system with three and four nucleons. 211 references. (tr-auth)

28184 NEUTRON-NEUTRON FINAL-STATE INTERACTION IN THE REACTION ^{2}H(n,2n)p AND THE $^1S_0$ SCATTERING LENGTH. Breunlich, W. H.; Tagesen, S.; Bertl, W.; Chalupka, A. (Institut fuer Radiumforschung und Kernphysik, Vienna). Nucl. Phys.; A221: No. 2, 269-284(1974).

By using a double time-of-flight spectrometer, a correlation spectrum of the two neutrons emitted at $\theta_1 = 17.8°$ and $\theta_2 = 11.0°$ was measured, while the energy of the recoil proton was also recorded. The results of this kinematically complete experiment were compared by means of the Monte Carlo technique to theoretical predictions of exact three-body calculations (Amado model (AM)) and the Watson-Migdal (WM) approximation. The best fit resulted in a neutron-neutron scattering length a_{nn}(AM) = −16.0 ± 1.2 fm. The WM result, a_{nn}(WM) = −16.8 ± 1.3 fm, is essential for confirming the estimate of the theoretical uncertainty. The absolute peak-area ratio expt./AM was 1.07 ± 20%. (6 figures, 2 tables) (auth)

28185 π^0-MESON PHOTOPRODUCTION ON COMPLEX NUCLEI AT $E_{\gamma\,max}$ = 400, 600, 700 MeV. Dudkin, G. N.; Eponeshnikov, V. N.; Krechetov, Yu. F.; Tryasuchev, V. A. (Inst. of Nuclear Physics, Electrons, and Atoms, Tomsk, USSR). Yadern. Fiz.; 19: No. 2, 311-316(Feb 1974). (In Russian).

The dependence of the π^0 photoproduction cross sections on nuclei upon the mass number A is measured. The produced pions with energy 60, 85, 130 and 195 MeV were detected at 120° laboratory angle. The results are compared with the quasifree photoproduction model. The pion-nucleus interaction in the final state is considered in the optical model. The obtained π^0 free paths satisfactorily agree with the models of Frank, Gammel and Watson. (auth)

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Refer also to abstracts 26893, 27813, 28167, 28179, 28185, 28222, 28243, 28246, 28265, and 28381.

28186 (CONF-730923-2) EFFECTIVE THREE-BODY FORCES IN TRUNCATED SHELL-MODEL CALCULATIONS. Barrett, B. R.; Halbert, E. C.; McGrory, J. B. (Arizona Univ., Tucson (USA). Dept. of Physics; Oak Ridge National Lab., Tenn. (USA)). 1973. 10p. Dep. NTIS $3.00.

From Symposium on correlations in nuclei; Balatonfured, Hungary (3 Sep 1973).

The problem of the determination of effective Hamiltonians to be used in shell model calculations in a truncated vector space is studied in more detail by undertaking a series of calculations

in which one can make a direct connection between a fixed Hamiltonian H, which describes the eigenenergies and eigenvectors of nuclei in a given mass range in some large shell-model vector space S, and an effective Hamiltonian H^1 to be used to describe some of the eigenvalues and eigenvectors of the same nuclei in a smaller (truncated) vector space S^1. These methods are applied to oxygen 19, fluorine 19, and neon 20. (JFP)

28187 (FRNC-TH-406) STUDY OF THE $^{12}C(h,p)^{14}N$ REACTION MECHANISM FOR INCIDENT ENERGIES OF BETWEEN 3 AND 11 MeV. Heusch, B. (Strasbourg-1 Univ., 67 (France)). 1973. 145p. (In French). Dep. NTIS (U.S. Sales Only) $9.25.

Thesis.

The $^{12}C(h,p)^{14}N$ reaction was experimentally investigated for incident energies consistent with the applicability range of the compound nucleus and the direct interaction theories. The ten bound ^{14}N states were studied from observations of the differential cross sections (excitation and angular distribution functions) and the total cross sections. Calculations were developed for the alignment of the bound levels, these calculations being characterized by the population factors. The reaction mechanism was determined from the form of the angular correlations calculated in colinear geometry. The results obtained between 3 and 11 MeV are compared with those of other workers (in the 35-MeV region); the comparison relates phenomena observed in nuclear reactions involving the ^{15}O compound nucleus. It was possible to demonstrate that the $^{12}C(h,p)^{14}N$ reaction up to E_h = 11 MeV proceeds by an ^{15}O compound nucleus. The contribution of a direct or semidirect mechanism whose probability is sensibly constant for $E_h \leq 11$ MeV seems to be apparent only in the dips of the curves for excitation energies $E_h \geq 8$ MeV. (FR)

28188 (FRNC-TH-437) QUASI-ELASTIC ELECTRON SCATTERING: METHOD FOR THE ANALYSIS AND STUDY OF ^{12}C NUCLEI. Berthod, J. (Clermont-Ferrand Univ., 63 (France)). 1972. 153p. (In French). Dep. NTIS (U. S. Sales Only) $10.75.

Thesis.

When the dynamic properties of nucleons in nuclei are studied using (e,e') quasi-elastic scattering, it is found that the associated radiative phenomena lead to the necessity of introducing important corrections. A complex deconvolution program requiring an accurate knowledge of the nuclear form factors over a wide range is necessary. The program used does not employ a nuclear model and uses only experimental data. In the case of light nuclei, it leads to an evaluation of the radiative tails within an accuracy of a few percent. The second difficulty occurring arises from the nondetection of emitted nucleons rendering the momentum of the nucleons in the nucleons relatively insensitive to the exact form of the distribution. The experimental confirmation of the inelastic sum rule demonstrates that the contribution of the dynamic nucleon-nucleon correlations to the inelastic cross section is small in comparison with the excitation of particles independent of the nucleus. Experimental results are presented for (e,e') scattering on ^{12}C, and comparisons made with theoretical results. The measurements correspond to a momentum transfer range lying between 100 and 350 MeV/c. Investigations of the scattering spectra demonstrate that the interpretation of the results depends upon whether the part of the spectra in front of the quasi-elastic peak or behind this peak is examined. In the lower part, the spectra exhibit two distinct peaks having the same amplitude (giant resonances, multipolar contribution of nonresonant partial waves). The upper part is due, essentially, to short range correlations between pairs of nucleons in the nucleus. These bumps are not predicted by theoretical models. In the most realistic hypothesis they are believed to be due to energy and momentum exchanges between the scattering nucleon and a neighboring nucleon. (auth)

28189 (INR-1474) ANALYSIS OF THE $^9Be(d,\alpha_0)^7Li$ AND $^9Be(d,\alpha_1)^7Li^*$(470 keV) REACTIONS IN TERMS OF THE TWO-NUCLEON DISTORTED WAVE BORN APPROXIMATION. Saganek, A.; Sledzinska, I.; Zwieglinski, B. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 31p. Dep. NTIS (U.S. Sales Only) $4.75.

Absolute differential and total cross sections for the $^9Be/d,\alpha/^7Li$ reactions leading to the ground and first excited /470 keV/ states were measured for bombarding energies of 2.25 to 3.1 MeV. An analysis of these reactions for energies of 0.9 to 3.1 MeV was performed in terms of the distorted wave Born approximation for two-nucleon transfer. (auth)

28190 (JINR-P15-7705) DETERMINATION OF THE SPIN AND PARITY OF THE LEVEL OF THE ^{12}C NUCLEUS (19.39 MeV) FROM THE ANALYSIS OF THE $^{11}B(p,3\alpha)$ REACTION. Dzhanobilov, K.; Komarov, V. V.; El'Takhavi, M. S. M.; Saad, Kh. R.; Sizov, I. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The coincidence spectra of two α particles from the $^{11}B(p,3\alpha)$ reaction at E_p = 3.75 MeV by the two-dimensional analysis method were measured. Experimental results are compared with calculations performed by many-particle scattering theory, taking into account pairing interaction of α particles in the final state. For the level of the ^{12}C compound nucleus with the excitation energy of 19.39 MeV, the values of spin and parity $J^\pi = 2^+$ were obtained. (7 figures) (auth)

28191 (LYCEN-7336) ABSORPTION OF MUONS BY NUCLEI. Joseph, J. (Lyon-1 Univ., 69 – Villeurbanne (France). Inst. de Physique Nucleaire). Jun 1973. 70p. (In French). Dep. NTIS (U. S. Sales Only) $6.50.

Thesis.

Muon nuclear capture is envisaged as a supplementary means for studying nuclear dynamics. The effective Hamiltonian is briefly recalled. Muon capture by nuclei for which N > Z is then studied. The introduction of current densities and their algebra demonstrate that the equalities between $M_{V,AP}^2$ are true for a whole class of nuclei even with N > Z (these equalities are rigorously true for the pure shell model, the spin orbit part of the mean potential bringing only slight changes to these equalities). The current density relations are used to generalize the Foldy-Walecka relations between the vectorial current and part of the photonuclear absorption cross section for the case when N > Z. The effect of the residual force was studied for the special case of ^{88}Sr in the framework of the Tamm-Dancoff method for the 0^-, 1^- and 2^- states. This force enables the resonant states of the dipole multiplet to be brought into the problem. It is shown that it is possible to adapt the nuclear reaction mechanism formalism to investigations of reactions induced by muon capture. This adaptation permitted numerous useful results obtained in the framework of this theory to be used in the concept of a doorway state. This formalism for muon nuclear reactions also made it possible to effect comparisons with experimentally measured values: neutron spectra, angular distributions, and polarization. The problem leads to the resolving of the Lippman-Schwinger equation. The application of the factorization method subsequently leads to a solution even for the case in which a large number of channels must be taken into account. The advantage of this method is the possibility of controlling the error introduced into the transition matrix elements while retaining the simplicity of the factorization method. The two examples treated (^{16}O and ^{48}Ca) in the simple framework of the 1 particle-1 hole model demonstrate that the results obtained are in good agreement with experiment. (FR)

28192 (USNDC-9, pp 121-122) DELAYED NEUTRON YIELD FROM THE $^9Be(n,p)^9Li$ REACTION FOR $14.1 \leq E_n \leq 14.9$ MeV. Augustson, R. H.; Menlove, H. O. (Los Alamos Scientific Lab., NM). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28193 (USNDC-9, pp 222; 224) POLARIZATION OF NEUTRONS IN n–^{16}O SCATTERING. Firk, F. W. K.; Bond, J. E.; Hickey, G. T.; Holt, R. J.; Nath, R.; Schultz, H. L. (Yale Univ., New Haven). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28194 COMPOUND NUCLEUS REACTION $^{12}C(^{11}B,2\alpha)^{19}N$. Eyal, Y. (Weizmann Inst. of Science, Rehovot, Israel); Beckerman, M.; Gutbrod, H. H. Nucl. Phys., A221: No. 1, 119-124 (1974).

Energy spectra and differential cross sections of nitrogen products formed in the reaction 28 MeV ^{11}B + ^{12}C were measured using a $\Delta E-E$ counter telescope. The energy spectra are smooth and therefore indicate that the nitrogen products were formed by a compound nucleus mechanism, via the formation and decay of the compound nucleus ^{23}Na. The experimental results are compared with statistical model calculations and good agreement is obtained. This result provides further evidence for the importance of the compound nucleus mechanism in heavy ion reactions with light nuclei and also gives added validity to the statistical model for light compound systems. (auth)

28195 THREE-BODY EFFECTS IN THE PION–NUCLEUS OPTICAL POTENTIAL IN THE (3,3) RESONANCE REGION. Kujawski, E. (Carnegie-Mellon Univ., Pittsburgh); Aitken, M. Nucl. Phys., A221: No. 1, 60-76(1974).

The π-nucleus optical potential is formulated within the framework of a three-body model in order to take into account the internal motion and binding effects of the target nucleons. The resulting lowest order optical potential depends on the fully-off-shell T-matrix and the density matrix of the target nucleus. It was explicitly evaluated for π^--^{12}C elastic scattering at 120

and 180 MeV in terms of the π-nucleon interaction of Desgrolard and Hammann and a shell-model description for ^{12}C. The optical potential is nonlocal and the resulting scattering amplitude is solved for in momentum space. The importance of the Fermi motion and binding of the target nucleons is investigated, and the corrections to the "factored or static" impulse approximation appear to be significant in this energy range. While reasonable fit is obtained for π^--^{12}C at 180 MeV, the same approach is rather unsatisfactory at 120 MeV suggesting the need for higher order terms or corrections. (auth)

28196 REACTION MECHANISM OF THE $^7Li(n,t\alpha)n$ REACTION AT E_n = 14.4 MeV. Antolkovic, B. (Institut Judjer Boskovic, Zagreb). Nucl. Phys., A219: No. 2, 332-346(1974).

The correlation spectra of the three-body break-up of the n + ^7Li system were studied at a neutron energy of 14.4 MeV. The analysis of the data reveals the predominant role of sequential processes. The Phillips-Griffy-Biedenharn theory has been applied to fit the data. The contribution of quasi-free scattering was also observed and analyzed in the frame of the PWIA. (auth)

28197 CONVERGENCE PROPERTIES OF THE PERTURBATION EXPANSION FOR THE EFFECTIVE TWO-PARTICLE INTERACTION IN MASS-18 NUCLEI IN A DOUBLY PARTITIONED HILBERT SPACE. Barrett, B. R. (Univ. of Arizona, Tucson). Nucl. Phys.; A221: No. 2, 299-318(1974).

The theory for calculating the effective interaction, V, for finite nuclei in a doubly partitioned Hilbert space is discussed and then applied to the calculation of V through third order in the nuclear reaction matrix G for the J = 0, T = 1 states in mass-18 nuclei. The G-matrix elements were computed by using the technique of Barrett, Hewitt and McCarthy, which allowed an accurate treatment of the Pauli projection operator. Calculations were first performed by using the standard procedure for computing V. These calculations were then repeated by employing the double-partition procedure, and its results were compared with those from the standard procedure. The convergence of the perturbation expansion for V through third order in G was improved in the double-partition approach but was not conclusive. The double-partition procedure, however, allows the possibility of performing much more sophisticated and accurate calculations of V than the standard procedure. All calculations were performed as a function of the starting energy, ω, of G, which is related to constant shifts between the energy levels of the occupied and unoccupied single-particle states. For all calculations a value of ω was found at which the 0^+ ground state agreed with experiment. A procedure was proposed for determining in advance the value of ω at which G and V should be computed. (7 figures, 7 tables) (auth)

28198 ALPHA PARTICLE MODEL CALCULATIONS FOR ^{12}C AND ^{16}O. Mendez-Moreno, R. M.; Moreno, M.; Seligman, T. H. (Universidad Nacional Autonoma de Mexico, Mexico City). Nucl. Phys.; A221: No. 2, 381-391(1974).

Spectra and form factors of ^{12}C and ^{16}O are calculated in the α-particle model. Empirical α−α interactions are used in a variational calculation in a translationally invariant harmonic oscillator basis. The validity of the α-particle model is discussed in view of the results, which show some nice qualitative features and fail quantitatively in some points. (8 figures, 2 tables) (auth)

28199 INTERFERENCE BETWEEN INELASTIC SCATTERING AND TRANSFER IN THE SCATTERING OF ^{16}O ON ^{17}O. Gelbke, C. K.; Baur, G.; Bock, R.; Braun-Munzinger, P.; Grochulski, W.; Harney, H. L.; Stock, R. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys.; A219: No. 2, 253-265(1974).

Angular distributions and an excitation function of the reaction $^{17}O(^{16}O, ^{16}O)^{17}O^*$ (0.871, $1/2^+$) were measured. The observed fine structure of the angular distributions cannot be explained by the dominating transfer process alone. An explanation is given in terms of interference between one-neutron transfer and inelastic scattering. (auth)

28200 MODEL DEPENDENCE OF THE (π^-,nn) REACTION. Jain, B. K. (Bhabha Atomic Research Centre, Trombay, India). Nucl. Phys.; A221: No. 2, 421-428(1974).

The recoil momentum distribution for the (π^-,nn) reaction on ^6Li is calculated by using the one- and two-nucleon absorption interactions and the α−d cluster model for ^6Li. It is found that the shapes of the distribution calculated with the two interactions do not differ much. Its magnitude, however, can differ substantially, depending upon the parameter of the correlation function in the one-nucleon model. From this and the comparison with the available experimental data it is argued that the two-nucleon model can be used to make a relative study of the correlations in nuclei, in addition to its utility for studying two-hole states in nuclei and the advantage of an easier formalism. (auth)

28201 ANALYSIS OF RESONANCE REACTIONS USING THE R-MATRIX THEORY. Laszlo, V. ATOMKI (At. Kut. Intez.) Kozlem.; 15: No. 4, 229-244(1973). (In Hungarian).

Following the description of the R-matrix theory used to calculate cross sections, some illustrative examples are given. (auth)

28202 SIMPLEST REACTION (p,2p) AND (p,pn). II. pp 34-58 of Yadernye Reaktsii pri Vysokikh Ehnergiyakh. Denisov, F. B.; Makhedov, V. N. (eds.). Moscow; Atomizdat (1972). (In Russian).

The (p,2p) and (p,pn) reactions are studied. A review is given of the results of the measurement of the energy of secondary protons during bombardment Li, Be, B, C, N, O, and Ca targets with 185-MeV protons. The measurement of the total energy of the escaping protons is equivalent to the measurement of the binding energy of ejected protons. The results of experiments made on the Upsala synchrocyclotron are reported. A comparison is made of the theoretical calculations and the experimental values of the differential effective cross sections of the angular correlation in the impulse approximation with wave distortion. The (p,pn) reactions are studied by the recoil nucleus method. The energy spectra and the angular distributions of the recoil nuclei are reported. (tr-auth)

28203 NUCLEAR RMS CHARGE RADII FROM RELATIVE ELECTRON SCATTERING MEASUREMENTS AT LOW ENERGIES. Fey, G.; Frank, H.; Schuetz, W.; Theissen, H. (Technische Univ., Darmstadt, Ger.). Z. Phys.; 265: No. 4, 401-403(Nov 1973).

The nuclear rms charge radii, measured by low energy electron scattering at Darmstadt, are summarized. Improvements in the experimental equipment and method permitted redetermination of the ^{12}C radius which yielded $R_m(^{12}C)$ = 2.462 ± 0.022 fm. This value was used to recalibrate the radii measured re'ative to ^{12}C. (GE)

28204 RADIAL DEPENDENCE OF TRANSITION CHARGE DENSITY AND NUCLEAR COMPRESSIBLE MODE. Fujii, S.; Kaise, Y. (Nihon Univ., Tokyo). Kakuriken Kenkyu Hokoku; 5: 159-167(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

Useful concepts of the effective charges and isospin selection rule for the E1 transition in self-conjugate nuclei are derived. Transition strengths among the different levels are compared for oxygen-16 and calcium-40. Form factors are discussed. (JFP)

28205 TOTAL CROSS-SECTIONS FOR THE NUCLEAR PHOTOEFFECT. Ahrens, J.; Borchert, H.; Eppler, H. B.; Gimm, H.; Gundrum, H.; Riehn, P.; Sita Ram, G.; Zieger, A.; Kroening, M.; Ziegler, B. (Max-Planck-Institut fuer Chemie, Mainz). Kakuriken Kenkyu Hokoku; 5: 213-224(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

Absolute measurements of photon absorption in the energy range from 10 to 140 MeV were performed in order to obtain the total cross section for the nuclear photoeffect. Calcium, beryllium, oxygen-16, carbon, aluminum-27, and silicon are considered. (JFP)

28206 ELECTRON AND NEUTRINO EXCITATION OF ^{12}C LEVELS. Ueberall, H. (Catholic Univ., Washington, DC). Kakuriken Kenkyu Hokoku; 5: 225-231(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The results of a calculation predicting the neutrino excitation of the analogs of the T = 1 levels in carbon-12, via the reaction $\nu + {}^{12}C \rightarrow {}^{12}N^* + l^-$, where l = electron or muon are presented. Differential and total cross sections and energy levels are discussed. (JFP)

28207 STUDY OF GIANT RESONANCE AND EXCITED STATE GIANT RESONANCE IN ^{28}Si AND ^{32}S INCLUDING 2p−2h STATES. Kamimura, M. (Kyushu Univ., Fukuoka). Kakuriken Kenkyu Hokoku; 5: 287-295(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

Resonances are investigated on the basis of the model which was proposed previously for the giant resonance of carbon-12. The coupling between the giant resonance and other modes is investigated from the microscopic viewpoint through the intermediate structure or splitting of giant resonance, and it is found

what is made clear about the problem by using the microscopic approach considering the full Pauli principle effect. (JFP)

28208 STUDY OF THE ^{19}F PHOTONEUTRON CROSS SECTION. Van de Vyver, R.; Ferdinande, H.; Knuyt, G.; Carchon, R.; Devos, J. (State Univ., Ghent). Kakuriken Kenkyu Hokoku; 5: 307-312(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The (γ,xn) cross section for fluorine-19 was studied, especially the detailed structure in the leading edge of the giant resonance (from threshold to 19 MeV). The neutron yield curve was measured as a function of bremsstrahlung endpoint energy. A striking fine structure appears in the cross sections below and in the giant resonance. (JFP)

28209 ELECTRON SCATTERING FROM LOW LYING 2^+ STATES IN ^{14}C. Crannell, H. (Catholic Univ. of America, Washington, DC); Hallowell, P. L.; O'Brien, J. T.; Finn, J. M.; Kline, F. J.; Penner, S.; Lightbody, J. W. Jr.; Fivozinsky, S. P. Kakuriken Kenkyu Hokoku; 5: 375-384(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

Results of measurements of the form factors and transition strengths for the electric quadrupole excitations of the 7.01 (2^+) and 8.32 (2^+) MeV states in carbon-14 are reported. Incident energies varied between 60 and 120 MeV. The inelastic cross section is obtained also. (JFP)

28210 (e,e'p) REACTIONS ON ^{6}, ^7Li, ^9Be, ^{12}C, ^{27}Al, ^{40}Ca, AND ^{51}V. Hiramatsu, S. (Tokyo Univ.); Kamae, T.; Muramatsu, H.; Nakamura, K.; Izutsu, N.; Watase, Y. Kakuriken Kenkyu Hokoku; 5: 429-438(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The momentum vectors of two outgoing particles are measured to obtain the separation energy and the momentum which the ejected proton had in the nucleus. (JFP)

28211 (e,e'd), (e,e'^{4}He) ON ^6Li. Genin, J. P.; Julien, J.; Letourneau, R.; Mougeot, A.; Rambaut, J.; Samour, C. (CEN de Saclay, Gif-sur-Yvette, France). Kakuriken Kenkyu Hokoku; 5: 439-442(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The (e,e'p) and (e,e'd')differential cross sections are directly compared in the case of lithium-6 at an incident energy of 520 MeV. (JFP)

28212 ANOMALOUS STRUCTURE IN THE QUASI ELASTIC PEAK OF ^{12}C. Berthot, J.; Isabelle, D. B. (Laboratoire de Physique Corpusculaire, Clermont-Ferrand, France). Kakuriken Kenkyu Hokoku; 5: 507-509(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

Measurements were performed on a carbon-12 target for incident energies from 200 to 350 MeV. The energy spectra and differential cross sections were found for quasi-elastic electron scattering. (JFP)

28213 ANOMALOUS RESULTS FOR THE $^9Be(\alpha,t)^{10}B$ AND $^{13}C(\alpha,t)^{14}N$ REACTIONS AT E_α = 27 MeV. Kemper, K. W.; Cotanch, S.; Moore, G. E.; Obst, A. W.; Puigh, R. J.; White, R. L. (Florida State Univ., Tallahassee). Nucl. Phys.; A222: No. 1, 173-186(1974).

Angular distributions for the reactions $^9Be(\alpha,t)^{10}B$ and $^{13}C(\alpha,t)^{14}N$ were measured at E_α = 27 MeV in the angular range 15° to 110° c.m. for transitions to the first four states in ^{10}B and the first five states in ^{14}N. Excitation functions for $^9Be(\alpha,t)^{10}B$ measured at the lab angles 25° and 45° in the energy range 26 to 27.5 MeV showed little structure, this result indicating a small compound-nucleus contribution. For both reactions the transition to the 0^+ T = 1 state is suppressed by at least a factor of five compared to the transition to the T = 0 states. DWBA and CCBA calculations gave a poor description of the data, and did not predict the suppression of the T = 1 transitions in the (α,t) reactions. A reanalysis of more recent (d,n) and (^{3}He,d) data in terms of the Cotanch–Robson isospin-dependent DWBA model, which explains the spectroscopic factor ratio for T = 1/T = 0 transitions in the two reactions, is also presented. (7 figures, 5 tables) (auth)

28214 ELASTIC TRANSFER OF A $1p_{\frac{1}{2}}$ HOLE IN THE SCATTERING OF ^{12}C ON ^{11}B. Bohne, W.; Gelbke, C. K.; Braun-Munzinger, P.; Grouchulski, W.; Harney, H. L.; Oeschler, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys.; A222: No. 1, 117-124(1974).

The elastic scattering of ^{12}C on ^{11}B was measured between 35° and 150° in the c.m. system at incident energies of 15, 17, 20, and 24 MeV. A consistent description of the data was obtained by including the elastic transfer, which is treated as the exchange of a $1p_{\frac{1}{2}}$ hole by using DWBA. (1 figure) (auth)

28215 ANALYSIS OF 1 GeV PROTON INELASTIC SCATTERING ON ^{12}C, ^{58}Ni, AND ^{208}Pb. Brissaud, I.; Bimbot, L.; Le Bornec, Y.; Tatischeff, B.; Willis, N. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett.; 48B: 319-322(18 Feb 1974).

High energy inelastic proton scattering to levels of ^{12}C, ^{58}Ni and ^{208}Pb is analyzed. The Glauber multiple diffraction model and microscopic wave functions are used. The theoretical results are compared with recent experimental data, and good agreement is obtained with a normalization factor consistent with analysis at lower energy. (auth)

28216 NUCLEAR MOLECULAR STRUCTURE IN HEAVY ION SCATTERING. Scheid, W.; Fink, H. J.; Mueller, H. (Univ., Frankfurt am Main). pp 144-178 of Proceedings of the Europhysics Study Conference on Intermediate Processes in Nuclear Reactions. Cindro, N. (ed.). New York; Springer-Verlag (1973).

From proceedings of the europhysics study conference on intermediate processes in nuclear reactions; Plitviec Lakes, Yugoslavia (31 Aug 1972). See CONF-720863-.

The possibility is discussed that nuclear molecules can be formed during the scattering process. It is shown that intermediate structures arise if molecular states are excited. The nucleus–nucleus potential, molecular states and their excitation, and a coupled-channel calculation for the carbon-12–carbon-12 system are considered. (JFP)

28217 MOLECULAR RESONANCES AND INTERMEDIATE PROCESSES IN HEAVY ION REACTIONS. A Review of Experimental Evidence. Stokstad, R. G. (Yale Univ., New Haven). pp 179-239 of Proceedings of the Europhysics Study Conference on Intermediate Processes in Nuclear Reactions. Cindro, N. (ed.). New York; Springer-Verlag (1973).

From proceedings of the europhysics study conference on termediate processes in nuclear reactions; Plitviec Lakes, Yugoslavia (31 Aug 1972). See CONF-720863-.

A review is given of the experimental evidence for molecular structure and intermediate processes in heavy ion reactions. Also experiments in which such effects were sought but were not observed are discussed. Cross sections and yields for various reactions between oxygen-16 and carbon-12 are considered. (JFP)

28218 QUASICLASSICAL APPROACH TO SPALLATION OF LITHIUM IN THE REGION OF NEAR-BARRIER ENERGIES. Titov, A. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 2, 292-299(Feb 1974). (In Russian).

Lithium spallation reactions in the region of near-barrier energies are analyzed in framework of the quasiclassical variant of the method of channel strong coupling. Dependence of the spallation cross section on the lithium structure parameters is studied, as well as the role of nuclear interaction in the reaction mechanism. Comparison with the available experimental data is carried out. (auth)

28219 ROTATIONAL SPECTRA OF LIGHT NUCLEI. Leinson, L. B. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 19: No. 2, 283-291(Feb 1974). (In Russian).

A scheme is presented to construct homogeneous harmonic polynomials as basic functions of irreducible representation of the group SU(3). This choice of the polynomials is found to be very suitable in description of rotational nuclear spectra in the method of hyperspherical harmonics and imposes strong selection rules on the K harmonics, a number of which is great for p- and sd-shell nuclei even in the minimal approximation. Numerical results of calculations for the ground rotational band of nuclei ^8Be and ^{12}C in the approximation $K = K_{min}$ are presented. (auth)

28220 ABSORPTION OF π^+ MESONS WITH ENERGIES 80 AND 112 MeV BY ^{14}N NUCLEI. Kosmach, V. F.; Martirosova, A. G.; Ostroumov, V. I. (Leningrad Polytechnic Inst.). Yadern. Fiz.; 19: No. 2, 241-244(Feb 1974). (In Russian).

Reaction $^{14}N(\pi^+,2p)3\alpha$ at the pion energy of 112 MeV is investigated by means of nuclear photoemulsion method. Integral and differential cross sections of this process, momentum spectrum and the excitation energy spectrum of the residual nuclei are obtained. Properties of the reaction at the pion energies of 80 and

112 MeV are compared, the Treiman–Yang analysis of the reaction is carried out, a deduction on the reaction mechanism is presented. (auth)

28221 DEUTERON-INDUCED REACTIONS ON ^{7}Li AT E_d = 180 keV. Hudomalj, J.; Tomas, P. (Inst. Ruder Boskovic, Zagreb). Fizika (Zagreb); 5: No. 4, 203-211(Dec 1973).

The d + ^{7}Li → α + α + n reaction was investigated at E_d = 180 keV using both α–α and α–n coincidence measurement techniques. An experimental technique was developed for studying nuclear reactions induced by low energy charged particles. The analysis of the results obtained confirms the predominance of the α + ^{3}He rather than the n + ^{8}Be reaction channel. In the case of the α–n coincidence measurement, the agreement of the data with the Phillips–Griffy–Biedenharn model can be improved by including a contribution of the direct three-body break-up. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 28062, 28185, 28186, 28201, 28205, 28210, 28246, 28253–28255, 28265, 28280, and 28364.

28222 (FRNC-TH-389) INELASTIC SCATTERING OF 33 MeV PROTONS ON ^{11}B AND ^{21}Ne. Interpretation in Terms of Rotational Band Mixing. Cavaignac, J. F. (Grenoble-1 Univ., 38 (France)). 1973. 102p. (In French). Dep. NTIS (U.S. Sales Only) $8.25.

Thesis.

The theoretical aspects of rotational band mixing are recalled together with the utilization of the wave functions obtained for the analysis of inelastic scattering. The results of the model are compared with those obtained experimentally for the following reactions: ^{11}B(p,p'), ^{21}Ne(p,p') and ^{21}Ne(p,d) at 30 MeV. It was shown that the rotational model with mixing enables a description to be obtained for the wave functions of the different states of ^{11}B and ^{21}Ne from a small number of intrinsic configurations and that this model is capable of reproducing sufficiently faithfully the electromagnetic properties of the states considered as well as the inelastic scattering cross sections of protons on these same states. (FR)

28223 (FRNC-TH-415) STUDY OF SOME ^{30}P NUCLEAR LEVELS USING THE ^{29}Si(d,n)^{30}P REACTION. Uzureau, J. (Nantes Univ., 44 (France)). 1972. 77p. (In French). Dep. NTIS (U.S. Sales Only) $7.00.

Thesis.

The angular distributions of neutrons emitted in the ^{29}Si(d,n)^{30}P reaction were analyzed for an incident energy of 4 MeV. Generally, the shapes obtained experimentally for these distributions are similar to those calculated theoretically with the two programs employed. The direct interaction mechanism appears to be dominant. Studies of the reaction enabled the parity to be fixed and the number of possible values for the spins of excited ^{30}P levels to be restricted (between 3.5 and 6 MeV): E(exc) = 5.41 MeV $J(\pi) = 0^-, 1^-, 2^-$; E(exc) = 5.91 MeV $J(\pi) = 2^-, 1^-$; E(exc) = 5.99 MeV $J(\pi) = 1^-$. In addition, the characteristics obtained for the ground state and 1.45-, 1.97-, and 4.62-MeV levels agree with experimental results previously obtained from other reactions. The presence of at least 4 negative-parity levels between 4.5 and 6 MeV excitation is an interesting result which might be used to test new wave functions. (FR)

28224 (FRNC-TH-430) ELECTROMAGNETIC TRANSITIONS IN THE ^{24}Mg NUCLEUS. Leccia, F. (Bordeaux-1 Univ., 33 (France)). 1973. 93p. (In French). Dep. NTIS (U. S. Sales Only) $7.75.

Thesis.

The ^{23}Na (p,γ)^{24}Mg radiative capture reaction was used to study excited states of the ^{24}Mg nucleus. This reaction exhibits a large number of isolated resonances in the $E_p < 3$ MeV energy range which enable all the bound levels up to an excitation energy of 10 MeV to be fed with the exception of the E_x = 9.52 MeV, $J^\pi = 6_1^+$ level. The γ branching ratios were determined, particular attention being given to the levels of the second rotational band, of which low-intensity transitions were observed or confirmed. The mean lives of some levels were measured and compared to the values obtained by other workers. Angular distribution measurements for the γ radiation enabled E2/M1 multipole transition mixings arising from $J^\pi = 2_2^+$, 3^+, and 5^+ levels to be determined. The reduced transition matrix elements were calculated from experimental data. The values are characteristic of those obtained for levels belonging to two rotational bands: highly enhanced E2-type transitions inside the two bands and of the order of 1 Weisskopf unit between the two bands; highly delayed M1-type transitions. The existence of two E2-type enhanced transitions was established: $0_2^+ \rightarrow 2_2^+$ and $2_1^+ \rightarrow 0_2^+$. They suggest the presence of a third rotational band relatively strongly mixed with the band built on the 2_2^+ state. The experimental results are then compared with predictions of different models proposed for the description of the ^{24}Mg nucleus. The models will reproduce the properties of the ground state band, but are not very successful at describing the band built on the 2_2^+ state. (FR)

28225 (FRNC-TH-443) STUDY OF NUCLEI OF THE s–d SHELL USING (^{3}He,α) REACTIONS. Berrier, G. (Paris-11 Univ., 91 - Orsay (France)). 1973. 120p. (In French). Dep. NTIS (U. S. Sales Only) $8.00.

Thesis.

Direct reactions involving the transfer of one nucleon excite final-nucleus states having wave functions which considerably overlap those of the initial nucleus, the latter presenting varying degrees of nucleon resemblance. Such reactions enable interesting data to be obtained for these states: angular momentum, parity, and the spectroscopic factor. These data were used to study neutron hole states in the nuclei of the s–d shell, N = 20 isotones being of particular interest. The same normalization constant was used for all the reactions studied. The optical potentials of ^{3}He and α particles were systematically investigated. It was shown that the variation of only one parameter is sufficient for the determination of potentials leading to the calculation of DWBA cross sections which are correct for the (^{3}He,α) reaction on ^{40}Ca, ^{39}K, ^{37}Cl, ^{31}P, ^{27}Al, and ^{23}Na. The utilization of this mean optical potential enabled absolute spectroscopic factors to be determined for all the levels of the different final nuclei. These factors had reasonable values when compared with theoretical factors or results of other pick-up reactions involving a neutron or a proton and when verifying the application of the sum rules. Under these conditions, the DWBA can be considered valid even at low energies, and the (^{3}He,α) reaction may be used as a spectroscopic tool. This tool, in addition to permitting the pick-up of a neutron on N = 20 isotones to be studied, allowed a very large number of odd–odd nuclei (N = Z = 11, 13, and 15) to be studied. The existence of new levels was established, and spins, isospins, and parities were proposed. The results facilitated the resolution of certain difficulties: the l = 0 missing intensity of ^{38}K was detected, and the 4^+, T = 1 missing level of ^{26}Al was identified. Generally speaking, the shell model with configuration mixing on a basis which involves only $d_{3/2}$, $s_{1/2}$, and $d_{5/2}$ shells explains sufficiently well the properties of positive-parity levels. The case of ^{30}P is peculiar. (FR)

28226 (INIS-mf-1106) SEARCH FOR GAMMA EMISSIONS FROM THE BETA-DECAYING ^{32}Si. Forberg, S. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden)). Feb 1971. 11p. INIS.

A source of 0.1 μCi of the rare nuclide ^{32}Si was produced and used in a search for gamma emissions between 20 and 200 keV by means of a coaxial Ge(Li) detector and a 400 channel analyzer. The one-week spectrum was smoothed in a computer. If any gamma quanta are emitted, their intensities are per one million disintegrations: <200 emissions above 20 keV; <20 above 30 keV; <10 above 50 keV; and <10 at 77 keV, the only known energy level of ^{32}P that might yield gamma emissions. (INIS)

28227 (INP-849) STATISTICAL ANALYSIS OF EXCITATION FUNCTIONS FOR ELASTIC AND INELASTIC SCATTERING OF ALPHA PARTICLES ON Mg AND Si NUCLEI. Bobrowska, A.; Budzanowski, A.; Grotowski, K.; Jarczyk, L.; Kamys, B.; Kapuscik, A.; Ploskonka, J.; Strzalkowski, A.; Wrobel, Z.; Zastawniak, L.; Zybert, R. (Institute of Nuclear Physics, Krakow (Poland)). Jul 1973. 17p. Dep. NTIS (U.S. Sales Only) $3.00.

The excitation functions for inelastic α scattering leading to the low-lying excited states in ^{24}Mg and ^{28}Si were measured at θ_{LAB} = 170°, 175°, and 179° in the LAB energy range 22.75 to 28.40 MeV. Statistical analysis of these excitation functions and those previously measured for elastic scattering was performed. The direct interaction contribution, y_D, to the reaction studied was obtained from probability distributions of cross sections and from correlation coefficients. Cross-correlation coefficients between different reaction channels were calculated. (5 figures, 3 tables) (auth)

28228 (USNDC-9, p. 98) LIFETIMES OF LEVELS IN ^{24}Ne. Watson, B. A.; Becker, J. A.; Fisher, T. R. (Lockheed Palo Alto Research Lab., CA). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28229 BREMSSTRAHLUNG INDUCED NUCLEAR REACTIONS WITH E_γ^{max} = 450 MeV. David, P.; Debrus, J.; Luebke, F.; Mom-

msen, H.; Schoenmackers, R.; Stein, G. (Univ., Bonn). Nucl. Phys., A221: No. 1, 145-162(1974).

The target nuclei ^{27}Al, ^{40,44}Ca, ^{51}V, ^{59}Co, ^{93}Nb, ^{nat}Ag, ^{181}Ta and ^{197}Au were irradiated with bremsstrahlung of E_γ^{max} = 450 MeV. Protons, tritons, ^{3}He and ^{4}He particles were detected on-line with an identification system using surface barrier detectors. Energy spectra, yields and angular distributions are given. The energy spectra are compared with calculated spectra from the compound nucleus model. (auth)

28230 PROTON POLARIZATION WITH ELASTIC SCATTERING ON ALUMINUM. Romanovskii, S. V. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 12, 2008-2011(Dec 1973). (In Russian).

The procedure of double scattering developed at the Institute of Nuclear Researches of the Academy of Sciences of the Ukrainian SSR is described. Rectangular geometry of the experiment, i.e., rectangular detector, was used for the decrease of pseudo-asymmetry contribution. Carbon was used as a polarizer. Polarization of protons P was 0.56 ± 0.05. Polarization of twice scattered protons by aluminium nucleus was measured on the basis of this procedure within a range of the angles 20 to 150°. The experiment results were analyzed by the optical model and by the diffraction theory of scattering. The phase analysis was carried out as well. The optimum set of parameters for the optical model and phase analysis was obtained as a result of calculation. Using the Spenser formula obtained within the limits of the diffraction theory of scattering, it is shown that the experiment results in the region of the angles greater than 80° are well described by the definite set of parameters. Under these conditions the parameter of the radius R for ^{27}Al proved to be equal to 3.7 fm which somewhat exceeds the average value, mentioned previously for the heavier elements. (auth)

28231 POLARIZED-PROTON INELASTIC SCATTERING ON ^{32}S AND POSSIBLE EVIDENCE OF A HEXADECAPOLE PHONON STATE. Lombard, R.M.; Raynal, J. (Centre d'Etudes Nucléaires de Saclay, 91190 Gif-sur-Yvette, France). Phys. Rev. Lett. 31: No. 16, 1015-1018 (15 Oct 1973).

Differential cross sections and analyzing powers for inelastic scattering of 24.5-Mev protons from ^{32}S have been measured, with special attention to the excitation of states which occur in the two-phonon region. The coupled-channel theory is used to interpret the excitation of the two-phonon states. An appreciably better fit to the data for the excitation of the second 2^+ state is obtained if a small admixture of the one-phonon state is assumed. However, a strong component of a 4^+ one-phonon state needs to be admixed to the 4^+ two-phonon state. (auth)

28232 ISOSPIN (SPIN) CORE POLARIZATION AND CHARGE EXCHANGE GIANT RESONANCES. Ejiri, H. (Osaka Univ.). Kakuriken Kenkyu Hokoku; 5: 261-271(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

Effects of giant resonances on β and γ transitions between low lying states were studied by investigating effective coupling constants g^{eff} for the following transitions; E1$\gamma(\tau_3 r Y_1)$, M2$\gamma(\tau_3 \sigma x r Y_1)$, first forbidden β $(\tau \pm r Y_1, \tau \pm \sigma x r Y_1)$, and μ meson capture $(\tau \pm r Y_1, \tau \pm \sigma x r Y_1)$. The uniform reduction rates $g^{eff}/g \simeq 0.3$ for both the transitions with and without spin operator indicate the possible existence of the isospin (spin) core polarization and the giant resonances associated with those transitions, (charge exchange E1, M2 gamma giant resonance, etc.). (auth)

28233 CROSS SECTIONS FOR ^{32}S$(\gamma,n)^{31}$S AND ^{32}S$(\gamma,p)^{31}$P. Thomson, J. E. M.; Stewart, R. J. J.; Thompson, M. N. (Univ. of Melbourne, Parkville, Australia). Kakuriken Kenkyu Hokoku; 5: 297-305(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The measurement of de-excitation gamma rays following the photodisintegration of sulfur-32 by bremsstrahlung with energies between 16 and 27 MeV was performed. Cross sections to excited states in sulfur-31 and phosphorus-31 are discussed. The single-particle excitation process and a multiple nucleon process are believed to account for the population of the levels. (JFP)

28234 COMMENT ON SHELL MODEL CALCULATION OF INELASTIC ELECTRON SCATTERING FORM FACTOR FOR EXCITED 0^+ AND 2^+ STATES IN ^{20}Ne. Sakakura, M. (Tokyo Univ.); Sebe, T.; Arima, A. Kakuriken Kenkyu Hokoku; 5: 499-505(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The structure of the s-d shell nuclei in the SU(3) shell model is investigated. Restriction is made mainly to inelastic electron scattering to the excited band O_2^+ state at 6.72 MeV and the 2_1^+ state at 7.43 MeV of that nucleus. (JFP)

28235 FURTHER STUDIES IN NUCLEAR DEFORMATION USING FOLDING MODELS. Mackintosh, R. S.; Tassie, L. J. (Australian National Univ., Canberra). Nucl. Phys.; A222: No. 1, 187-203(1974).

Inelastic scattering from ^{20}Ne and ^{24}Mg was studied by using a folding collective model described previously. The sensitivity of the (α,α') reaction to various ways of deforming the nucleus along the lines suggested by Satchler was studied. The reaction gives a surprisingly stable value of the quadrupole moment and also determines the hexadecapole moment fairly unambiguously; however, it leaves considerable ambiguity in other features of the surface structure. (7 figures, 5 tables) (auth)

28236 STUDY OF THE $E(p) = 1.118$ MeV RESONANCE IN THE ^{27}Al$(p,\gamma)^{28}$Si REACTION. Dalmas, J. (Univ., Bordeaux). Compt. Rend., Ser. A, B; 277: No. 15, 435-437(15 Oct 1973). (In French).

Studies of the $E^p = 1.118$-MeV resonance enabled measurements to be effected on the lifetimes of the 8.413-, 8.589-, 9.700-, and 11.432-MeV levels of the ^{28}Si nucleus. The Doppler shift attenuation method was used. Studies of the angular distribution of the γ radiation observed at this resonance enabled the multipole mixing of some transitions to be measured and the $J_\pi = 4^-$ spin and parity to be established for the 8.413- and 11.432-MeV levels. Intensity measurements of this resonance yielded 8.5 ± 0.9 eV. (auth)

28237 BUBBLES AND THE ODD-STATE FORCE. Saunier, G.; Rouben, B.; Pearson, J. M. (Univ. of Montreal). Phys. Lett.; 48B: No. 4, 293-296(18 Feb 1974).

It is shown that the formation of bubbles in spherical Hartree-Fock calculations on ^{36}A depends sensitively on the odd-state effective interaction, being strongly favored, like alpha clustering, when this is repulsive. (auth)

28238 (n,α) REACTION IN ^{28}Si, ^{54}Fe, AND ^{197}Au. Ali, F. (Dacca Univ., India); Siddiq, A. K. M.; Islam, M.; Rahman, F.; Sanaullah. Nucl. Sci. Appl., Ser. B; 6: 45-47(Oct 1973).

The energy levels of ^{25}Mg and ^{51}Cr were measured from (n,α) reaction in ^{28}Si and ^{54}Fe respectively, and the yield of alpha-particles from ^{197}Au (n,α) ^{194}Ir reaction was determined using a silicon surface barrier detector. Neutrons were obtained from T(d,n) ^{4}He reaction with a 3 MeV Van de Graaff accelerator. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 28202, 28204, 28205, 28210, 28215, 28225, 28229, 28232, 28238, 28255, 28261, 28265, 28280, 28290, 28302, 28309, and 28385.

28239 (FRNC-TH-423) ELASTIC SCATTERING OF 30 MeV DEUTERONS ON ^{40}Ca, ^{56}Fe, ^{90}Zr, AND ^{208}Pb. Establishment of the Existence of the Deuteron-Nucleus Tensor Interaction. Roche, R. (Grenoble-1 Univ., 38 (France)). 1973. 90p. (In French). Dep. NTIS (U.S. Sales Only) $6.50.

Thesis.

Experiments were performed using vector- and tensor-polarized deuterons having energies of 30 MeV and 28.8 MeV on ^{40}Ca and ^{56}Fe, and ^{90}Zr and ^{208}Pb nuclei, respectively. In the case of elastic scattering, the differential cross section, the vector analyzing power iT_{11} and the tensor quantity $T_{22} - \sqrt{(1/2)}T_{20}$ were measured. The results are analyzed in the framework of the optical model. The experimental equipment is described together with the polarization of the beam. The experimental angular distributions of the reduced differential cross section for the vector polarization and the tensor quantity, $T_{22} - \sqrt{(1/2)}T_{20}$, are represented at 30 MeV for ^{40}Ca, ^{56}Fe and at 28.8 MeV for ^{90}Zr and ^{208}Pb. (Only statistical errors are given on the polarization curves). The large values measured for the tensor polarization led to the establishment of the existence of a tensor deuteron-nucleus interaction from the analysis of these quantities using the optical model. The measurements effected enabled the magnitude of the tensor potential T_r used in the analysis to be evaluated, this potential being attractive and having a depth of between 0.5 and 2 MeV for a radius r_T of 1.4 fm, with the form factor used taken into account. (FR)

28240 (FRNC-TH-445) SPECTROSCOPIC STUDY OF ^{53}Co USING ^{53}Fe(p,n)^{53}Co, ^{54}Fe(p,nγ)^{53}Co, AND ^{55}Mn(α,nγ)^{53}Co REACTIONS. Gehringer, C. (Strasbourg-1 Univ., 67 (France)). 1973. 163p. (In French). Dep. NTIS (U.S. Sales Only) $11.25.

Thesis.

The simultaneous use of several spectroscopic methods (study of spectra, lifetime measurements, and measurements of angular correlations and the gyromagnetic ratio) enabled nuclear characteristics of ^{53}Co to be established. The neutron threshold detection method and the γ ray threshold excitation method were used to establish the existence of seven excited levels and to determine their de-excitation schemes. The pulsed beam technique was used for mean life measurements of the 53.2-keV level. The 111.5-keV level was investigated using the delayed coincidence method. The Doppler attenuation method was used to measure the mean lives of eight other levels populated by the ^{55}Mn(α,nγ) reaction. The gyromagnetic ratio of the 111.5-keV level was determined from measurements of the angular distribution of γ radiation from this level, this distribution being perturbed by the hyperfine field for Co nuclei implanted in an iron matrix (integral method). The spins of the 53.2, 111.5, 365.6, 373.7 and 457.4 levels were measured using the angular correlation method in the Litherland and Ferguson II geometry. Shell model theory assigned a configuration to the ground state of ^{53}Co which agrees very well with the results obtained from transfer reactions, which also suggest weak mixing of the $\nu 2p_{\frac{1}{2}}1f_{\frac{5}{2}}$ neutron shell. (FR)

28241 (USNDC-9, p 71) NEUTRON RESONANCE SPECTROSCOPY. XIV. Potassium. Singh, U. N.; Liou, H. I.; Hacken, G.; Slagowitz, M.; Rahn, F.; Rainwater, J.; Makofske, W.; Garg, J. B. (Columbia Univ., New York). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28242 (USNDC-9, pp 73-75) MEASUREMENT OF THE CONTINUUM GAMMA RAY PRODUCTION CROSS SECTIONS FOR IRON. Rogers, V.; Hoot, C.; Orphan, V. (Intelcom Rad Tech, San Diego, CA). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28243 TREATMENT OF RENORMALIZATION, POTENTIAL ENERGY OF INTERMEDIATE STATES, AND RE-ARRANGEMENT EFFECTS IN BRUECKNER CALCULATIONS OF CLOSED SHELL NUCLEI. Grange, P.; Preston, M. A. (McMaster Univ., Hamilton, Ont.). Nucl. Phys., A219: No. 2, 266-294(1974).

In the Brueckner-Hartree-Fock theory of finite nuclei, the problems of renormalization, potential energy of intermediate states and re-arrangement effects are examined. For practical calculations it is shown that satisfactory solutions to them can be obtained if the parametrization chosen for the single-particle potential in finite nuclei is linked closely to nuclear matter results. The link is made with similar problems in the density dependent Hartree-Fock theory, and the possibility of such a parametrization is emphasized by recalling the existence of a formal solution for the Hartree-Fock single-particle potential if the effective interaction is of the δ-function type. A method of solution of the Bethe-Goldstone equation is then presented which separates the intermediate states into those of an "open shell" and of a "continuum". Finally results of model calculations of ^{16}O and ^{40}Ca with harmonic oscillator functions are presented in which the parametrization chosen for the BHF single-particle potential is taken from the Skyrme-Vautherin δ-function force. A self-consistent determination of certain parameters of this form of force leads to values in close agreement with the empirical estimate made by Vautherin and Brink in ^{16}O, with the exception of the spin-orbit splittings. Limitations and possible improvements of this type of approach are discussed for ^{40}Ca. (auth)

28244 CORE-EXCITED STATES OF ^{54}Fe FROM THE ^{56}Fe (p,t)^{54}Fe REACTION AT 52 MeV. Suehiro, T. (Tokyo Univ.); Kokame, J.; Ishizaki, Y.; Ogata, H.; Sugiyama, Y.; Saji, Y.; Nonaka, I.; Itonaga, K. Nucl. Phys., A220: No. 3, 461-476 (1974).

The (p,t) reaction on ^{56}Fe was studied at a bombarding energy of 51.9 MeV using a broad-range magnetic spectrometer. States of ^{54}Fe were identified up to an excitation energy of 7.6 MeV. Differential cross sections were obtained for 16 triton groups. From the shapes of angular distributions $J^\pi = 0^+, 2^+, 3^-$ and 4^+ were assigned for 11 levels. The 0^+ state 2.56 MeV was strongly excited (≈27% of the ground state transition). Comparison with the DWBA calculation was made based on the shell-model calculation on ^{54}Fe with $(f_{\frac{7}{2}})^{-(n+2)}(p_{\frac{3}{2}},f_{\frac{5}{2}},p_{\frac{1}{2}})^n$ configurations for the low-lying even-parity states. The agreement with the experimental results was satisfactory for most of the states with appreciable (p,t) strengths which were interpreted as core-excited states mostly with 3h-1p and 4h-2p configurations. An empirical normalization constant of 12.5 was derived from the L = 0 ground state transition. (auth)

28245 PROPERTIES OF LOW-LYING LEVELS OF ^{45}Sc. Rust, N. J. A.; Naude, W. J.; Koen, J. W.; Mouton, W. L. (Univ. of Stellenbosch, S. Afr.). Nucl. Phys., A219: No. 2, 232-244 (1974).

The spins and electromagnetic properties of levels up to 1800 keV in ^{45}Sc were studied by means of inelastic proton scattering. Results are discussed with reference to the excited-core model. (auth)

28246 PROTON–NUCLEUS ELASTIC SCATTERING AT 156 MeV. Comparat, V.; Frascaria, R.; Marty, N.; Morlet, M.; Willis, A. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys.; A221: No. 2, 403-413(1974).

Cross sections for the elastic scattering of 156-MeV protons on eleven targets ranging from ^{12}C to ^{209}Bi were measured, and an optical-model analysis was performed. The effect of different optical potentials in DWIA inelastic-scattering calculations is shown by some examples. (7 figures, 3 tables) (auth)

28247 ANALYSIS OF INELASTIC SCATTERING TO THE 2^+ STATE IN ^{54}Fe AT 1.409 MeV. Smith, R.; Amos, K. (Univ. of Melbourne). Aust. J. Phys.; 26: No. 5, 575-584(Oct 1973).

The differential cross section, spin-flip probability amplitude, and asymmetry for the inelastic scattering of 19.6-MeV protons to the 2^+ state in ^{54}Fe at 1.409-MeV are analyzed. The antisymmetrized distorted wave approximation is used to evaluate the scattering amplitudes in which the reaction mechanism is represented by a generalized core polarization model. Good fits are obtained to the differential cross section and spin-flip probability data. The exchange core polarization contributions are shown to be essential to obtain such fits. However, the asymmetry data cannot be fitted simultaneously, and this failure demonstrates the limitations of the current collective model representation of the core polarization process. (auth)

28248 STUDY OF THE LOW-LYING LEVELS IN ^{55}Fe FROM THE (d,t) REACTION ON ^{56}Fe. Majumder, A. R.; Sen Gupta, H. M. (Univ. of Dacca, Bangladesh). Indian J. Phys.; 47: No. 7, 396-401(Jul 1973).

A study of the low lying levels in ^{55}Fe was made from the ^{56}Fe (d,t) reaction at 12 MeV. The angular distributions exhibit J-dependence effect; data were analyzed in terms of the DWBA theory of direct reaction, and spectroscopic factors were derived. Results were compared with those given by stripping and other pickup reactions. (auth)

28249 INELASTIC ELECTRON SCATTERING ON SINGLE CLOSED SHELL NUCLEI. Ho, P. X.; Bellicard, J. B.; Leconte, P.; Sick, I. (CEN de Saclay, Gif-sur-Yvette, France). Kakuriken Kenkyu Hokoku; 5: 125-130(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

A study is made of the 2^+, 3^-, and 4^+ states of N = 28 isotones (titanium-50, chromium-52, and iron-54), N = 50 isotones (zirconium-90, molybdenum-92) and Z = 50 even tin isotopes (tin-116, tin-120, and tin-124). Cross sections were measured over a range of momentum transfer of 0.6 to 2 fm^{-1}. Also absolute cross sections were determined for 209-MeV electron inelastic scattering. (JFP)

28250 CONTRIBUTIONS OF NEUTRONS TO ELASTIC ELECTRON SCATTERING FROM NUCLEI. Bertozzi, W.; Friar, J.; Heisenberg, J.; Negele, J. W. (Massachusetts Inst. of Tech., Cambridge). Kakuriken Kenkyu Hokoku; 5: 145-158(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The effects due to a nonzero neutron charge density and relativistic corrections to the electromagnetic interactions of electrons with nucleons are examined. The nuclei calcium-40 and lead-208 are considered. (JFP)

28251 GIANT MULTIPOLE RESONANCES IN MEDIUM AND HEAVY NUCLEI OBSERVED BY INELASTIC ELECTRON SCATTERING. Torizuka, Y.; Kojima, Y.; Saito, T.; Itoh, K.; Nakada, A.; Mitsunobu, S.; Nagao, M.; Hosoyama, K.; Fukuda, S. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 5: 171-184(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The possibility of giant multipole resonances other than the usual giant dipole resonance was investigated. A large resonance peak was found systematically just below the dipole state. These

resonances were found to be of E2- or E0-like character. The transition strengths were evaluated. Also another broad bump was found at an energy higher than the giant dipole resonance. Spectra are shown for iron-56, lead-208, zirconium-90, tin-116, cadmium-114, and lead-106 at energies of 150 to 250 MeV. Form factors are discussed. (JFP)

28252 COLLECTIVE POTENTIALS AND THE SPLITTING OF GIANT RESONANCE. Rezwani, V.; Brand, M.; Sedlmayr, R.; von Bernus, L.; Schneider, U.; Greiner, W. (Univ., Franfurt am Main). Kakuriken Kenkyu Hokoku; 5: 235-260(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The usefulness of the collective model developed by G. Gneuss et al. is demonstrated by considering the collective spectra of ^{40}Ca, ^{114}Cd, ^{142}Nd, ^{144}Nd, ^{146}Nd, ^{148}Nd, ^{150}Nd as examples. The realistic potential energy surface and the low energy spectra of these nuclei are constructed empirically by a suitable choice of stiffness and mass parameters. The giant dipole resonances of the Nd-isotopes were calculated in the framework of dynamic collective model of giant resonances. Good agreement with the experimental data is obtained. By coupling the low energy oscillations to the high energy density fluctuations, one could explain and understand the experimental data of Carlos et al., who clearly observed a splitting of the γ-absorption cross section of the deformed ^{150}Nd nucleus. (auth)

28253 MECHANISM OF HEAVY ION COLLISIONS LEADING TO A COMPOUND SYSTEM AND TO DEEP INELASTIC REACTIONS. Gross, D. H. E.; Kalinowski, H. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Phys. Lett.; 48B: No. 4, 302-306(18 Feb 1974).

A model is presented that describes the dynamics of heavy ion collisions leading into the compound system. By including an anisotropic friction and using folding potentials it is able to reproduce most of the data on the compound formation cross section. In addition the qualitative features of deep inelastic direct reactions appear in a natural way. (auth)

28254 MECHANISM OF FAST NEUTRON RADIATIVE CAPTURE. Cvelbar, F. (Univ. of Ljubljana, Yugoslavia). pp 278-294 of Proceedings of the Europhysics Study Conference on Intermediate Processes in Nuclear Reactions. Cindro, N. (ed.). New York; Springer-Verlag (1973).

From proceedings of the europhysics study conference on intermediate processes in nuclear reactions; Plitviec Lakes, Yugoslavia (31 Aug 1972). See CONF-720863-.

A description is given of the radiative capture of neutrons if the intermediate system is excited to the region of the giant dipole resonance, about 20 and 15 MeV for light and heavy nuclei, respectively. Cross sections and excitation functions lead-208, silicon-28, strontium-88, and calcium-40. (JFP)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 27813, 28185, 28191, 28229, 28232, 28246, 28253, 28254, 28280, and 28302.

28255 (AE-485) OPTICAL MODEL CALCULATION OF FAST NEUTRON ELASTIC SCATTERING CROSS SECTIONS FOR SOME REACTOR MATERIALS. Etemad, M. A. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Feb 1974. 163p. Dep. NTIS (U.S. Sales Only) $11.25.

Neutron total and differential elastic scattering cross sections have been calculated for the elements Na, Al, Si, V, Mn, Fe, Co, Ni, Cu, Y, Nb and Pb in the energy range of 1.5 to 8.5 MeV and in steps of 0.5 MeV. The calculations have been done on the basis of the nuclear optical model using a set of generalized optical model parameters which are independent of the incident neutron energy but are a function of mass number. The compound elastic contribution to the elastic scattering cross section has been calculated using Hauser–Feshbach formalism. The calculated neutron elastic scattering angular distributions have been compared with those measured by different experimenters to check the validity of the generalized optical model parameters for estimation of the elastic scattering cross sections for applied purposes. Comparisons have also been made between the calculated total and total elastic cross sections of the present work and the corresponding experimental data found in the literature. (auth)

28256 (CEA-N-1661) MEASUREMENT OF NEUTRON RADIATIVE CAPTURE CROSS SECTIONS OF Cr, Fe, AND Ni BETWEEN 70 AND 550 keV. Le Rigoleur, C.; Arnaud, A.; Taste, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13—Saint-Paul-les-Durance (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees). Aug 1973. 60p. (In French). Dep. NTIS (U. S. Sales Only) $6.00.

The absolute values of the neutron radiative capture cross sections of Cr, Fe and Ni were determined between 70 and 550 keV using the total energy weighting technique. The γ radiation produced by the cascade was detected with a nonhydrogenated liquid scintillator. A ^{10}BNaI(Tl) detector of well known efficiency was employed to measure the neutron flux. Time-of-flight techniques were used in conjunction with an on-line computer. (auth)

28257 (INIS-mf-947) INVESTIGATION OF ^{89}Y AND ^{87}Rb BY HIGH RESOLUTION INELASTIC PROTON SCATTERING EXPERIMENTS. Hulstman, L. (Vrije Universiteit, Amsterdam (Netherlands)). 22 Mar 1973. 84p. INIS.

The choice of a magnetic spectrograph as detection apparatus for the experiments is argued, and the experimental set up and procedures are described. New data concerning the high resolution inelastic scattering of ^{87}Rb are presented. The experiments on ^{89}Y in the excitation energy range of 2 to 4.2 MeV and their results are discussed. For the analysis of the experimental data the distorted wave Born approximation is used. Experiments were made in order to determine the states in ^{89}Y and ^{87}Rb by considering them as originating from the coupling of a proton or proton-hole respectively with a ^{88}Sr core. The results of the experiments are compared with rough predictions based on this conception. In general a qualitative agreement was found, however, it is not yet possible to relate the individual levels in ^{89}Y and ^{87}Rb with their so-called parent states in ^{88}Sr. Arguments are given for the presence of some states theoretically predicted but experimentally not yet identified in ^{88}Sr and for the need to reinvestigate ^{88}Sr very exactly. (auth)

28258 (INIS-mf-949) SCATTERING OF 3 MeV POLARIZED NEUTRONS BY SIX ELEMENTS. van Hall, P. J. (Vrije Universiteit, Amsterdam (Netherlands)). 1 Sep 1972. 83p. INIS.

Experiments were carried out on the scattering of 3 MeV polarized neutrons produced by the D(d,n)^{3}He reaction by six elements—Ni, Fe, Zr, Sn, Pb and Bi. The results of the scattering experiment on the six elements are presented, preceded by a short discussion of the initial neutron polarization. The corrected results are compared with optical model calculations using some standard potentials. Rather large differences were found between neighboring elements. Thus, the data cannot be described accurately by combining the optical model and the statistical model. The origin of this failure is presumably that one of the basic concepts of the statistical model is not fulfilled, namely the randomness of the phases of the different compound nucleus levels. Even at forward angles where compound nucleus effects are small, deviations from the optical model values occur. (JFP)

28259 (INIS-mf-1005) NUCLEAR SUPERFLUIDITY AND THE SHELL MODEL. Study of the Number Projected BCS Model and Application to Isotones with 50 Neutrons. Allaart, K. (Vrije Universiteit, Amsterdam (Netherlands)). 25 Aug 1972. 150p. INIS.

The spurious states in the BCS theory and the particle number projection are dealt with. The discrepancies between the wave functions of single-closed-shell nuclei as obtained from the BCS and those from the FBCS formalism are discussed. The difference between the BCS and FBCS two-quasiparticle spectra become large when the number of particles corresponds to a closed subshell structure and if subshells of low degeneracy occur near the Fermi level. The states of the even N = 50 nuclei are calculated in both approximations and compared to those of the shell model with seniority quantum number ≤2. The single-quasiparticle description of odd superfluid nuclei by BCS theory and by particle number projection methods are compared with the exact lowest seniority shell models. The purpose is to trace systematic inadequacies of the inverse gap equations (IGE) method to extract single-particle energies from spectroscopic data on odd nuclei and to improve that method by using number projection techniques. Spectra of the even single-closed-shell nuclei with 50 neutrons are calculated. Spectroscopic factors for one-nucleon transfer reactions and electromagnetic decay rates are calculated using the simple number projected two-quasiparticle wave functions. For ^{88}Sr and ^{90}Zr the spectroscopic factors agree with the experimental ones, but the electric transition rates in ^{90}Zr require an extension of the configuration space. (auth)

28260 (INIS-mf-1006) LIFETIMES OF EXCITED STATES IN NUCLEI WITH MASS NUMBER AROUND A = 88 BY MEANS OF THE DOPPLER SHIFT ATTENUATION METHOD. Beens, W. (Vrije Universiteit, Amsterdam (Netherlands)). 20 Sep 1973. 99p. INIS.

Nuclei in the mass region around A = 88 are of interest since according to the shell model the ^{88}Sr nucleus consists of protons

and neutrons in closed shells. So in a simple approach the levels in nuclei with some additional particles may result from the excitation of the ^{88}Sr core (collective model states) and by the rearrangement of particles outside this core (shell model states). In experiments on these nuclei lifetimes were measured of nuclear states which decay by gamma emission. From an estimate with the aid of the single particle model the expected lifetimes are smaller than 10^{-12} s for a lot of levels in several nuclei. Depending on the length of the lifetime different methods can be applied. It is described why the Doppler shift attenuation method was chosen. This method applies the time dependence of the energy shift of gamma radiation emitted by moving excited nuclei. This time dependence and the reliability of the method are discussed. Since the energy shifts are expected to be small a test experiment on the first excited states in ^{58}Ni was done in order to demonstrate that the used apparatus meets the requirements. The experiments carried out on the nuclei ^{89}Y, ^{91}Nb, ^{90}Zr and ^{96}Zr are described. After the determination of the lifetimes and the transition probabilities special attention is paid to the identification of shell model features and collective ones. (auth)

28261 (INIS-mf-1008) POLARIZATION MEASUREMENTS AND OPTICAL MODEL ANALYSES OF NEUTRON SCATTERING AT 3.2 MeV. Zijp, E. (Vrije Universiteit, Amsterdam (Netherlands)). 30 Nov 1972. 87p. INIS.

The optical model was investigated with the elastic scattering of neutrons. Polarization data were measured existing of angular distributions from 30 to 150° for Ti, Cr, Ni, Sr, Zr, Mo, Sn, Ba, Bi and distributions limited to the forward angles from 30 to 75° for Fe, Cu, Zn, Nb, Ag, Cd, Sb, Te, W, Tl, and Pb. All elements consisted of a natural mixture of isotopes. The polarization of the D(d,n)^{3}He neutrons was −15% for the energy region 350 to 650 keV. It was determined if the polarization data could be described with known potentials for neutron scattering and secondly individual analyses for the separate nuclei were made. None of the used global potentials give a good fit for the angular distributions and also individual analyses do not give very satisfactory results. In order to find a better explanation the influence of direct excitation of low lying collective levels on the elastic scattering was investigated. This is done by coupled channel calculations based on a nonspherical optical potential and fitting of these results with an equivalent spherical potential. Coupling of the elastic with the direct inelastic scattering is important particularly at low energy. It can also explain at least qualitatively the difficulties in the analyses with the spherical optical potential. (auth)

28262 (ORNL-TM-4523) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH ZINC. Tabulated Differential Cross Sections for 31 Gamma Rays for Incident Neutron Energies Between 0.9 and 6 MeV. Slaughter, G. G.; Dickens, J. K. (Oak Ridge National Lab., Tenn. (USA)). Apr 1974. Contract W-7405-eng-26. 33p. Dep. NTIS $4.75.

Numerical values of differential cross section for gamma rays produced by neutron interactions with zinc were measured for neutron energies between 0.9 and 6 MeV for σ_γ = 120 deg. The $d\sigma/d\omega$ data were obtained using a 35 cm^3 Ge(Li) detector. The data consist of cross section values for 31 gamma rays having E_γ between 300 and 2780 keV. Neutron energy intervals varied between a minimum of ~50 keV at E_n ~ 900 keV and a maximum of ~1.5 MeV for E_n ~ 5.8 MeV. (auth)

28263 (USNDC-9, pp 52; 54-55) ^{59}Co(n,γ)^{60}Co. Rimawi, K.; Wasson, O. A.; Chrien, R. E. (Brookhaven National Lab., Upton, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28264 ENERGIES AND MIXING RATIOS OF TRANSITIONS IN ^{72}Ge. Chen, H. (Saginaw Valley Coll., University Center, MI); Gardulski, P. L.; Wiedenbeck, M. L. Nucl. Phys., A219: No. 2, 365-369(1974).

The lower energy γ-rays of ^{72}Ge from the decay of 14 h ^{72}Ga were studied using a 2 m curved-crystal spectrometer. Mixing ratios for the 601, 630, 894 and 1051 keV transitions were determined from the γ−γ directional correlations. The E0 content of the 630 keV, $2^{+\prime} \rightarrow 2^+$ transition was found to be less than 2%. A spin of 3 for the 2065 keV level was uniquely determined. (auth)

28265 (^{6}Li,^{6}He) REACTION ON THE TARGETS ^{19}F, ^{27}Al, AND ^{58,60,64}Ni. Gaarde, C. (Univ. of Rochester, NY); Kammuri, T. Nucl. Phys.; A221: No. 2, 238-252(1974).

Angular distributions were measured for the (^{6}Li,^{6}He) reaction on the targets ^{19}F, ^{27}Al [E(^{6}Li) = 34 MeV] and ^{58,60,64}Ni [E(^{6}Li) = 36 MeV]. Upper limits are given for the cross sections for the ^{40}Ca(^{6}Li,^{6}He)^{40}Sc and ^{88}Sr(^{6}Li,^{6}He)^{88}Y reactions at E(^{6}Li) = 38 MeV. The spectra were obtained with 60-cm-long position sensitive counters in a magnetic spectrograph with a resolution around 50 keV. A strong Q-value dependence on the cross section is observed. The data are analyzed using DWBA with a microscopic description of the reaction. The $\sigma\sigma\tau\tau$ two-nucleon force strength extracted from the analysis shows variations that indicate that two-step processes could be important. (9 figures, 1 table) (auth)

28266 ISOBARIC ANALOG RESONANCES IN (e,e'p) ON ^{90}Zr, ^{89}Y, AND ^{88}Sr. Shoda, K.; Sugawara, M.; Saito, T.; Miyase, H. (Tohoku Univ., Sendai). Nucl. Phys.; A221: No. 1, 125-144(1974).

Photoproton energy and angular distributions were measured for the (e,e'p) reaction on ^{90}Zr, ^{89}Y and ^{88}Sr at a number of electron bombarding energies. Proton groups passing through resonances are found in the energy distributions. The dependence on the residual states is studied, and it is found that a large contribution from core excitation exists in the strong E1 IAS. The configurations of these IAS are discussed with respect to the angular distributions. Cross sections of the (γ,p_0) reaction were extracted from the photoproton spectra. The results show a coherent T + 1 resonance in good agreement with theory. The E1 IAS are compared with the results from various types of nuclear reactions. Strengths of the IAR are found to depend on the type of reaction. (16 figures, 5 tables) (auth)

28267 MEASUREMENT OF DELBRÜCK SCATTERING AND OBSERVATION OF PHOTON SPLITTING AT HIGH ENERGIES. Jarlskog, G.; Jönsson, L. (University of Lund, Sweden); Prünster, S.; Schulz, H.D.; Willutzki, H.J.; Winter, G.G. Phys. Rev. D 8: No. 11, 3813-3823 (1 Dec 1973).

The differential cross section for Delbrück scattering has been measured at photon energies between 1 and 7 GeV and scattering angles between 1 and 3 mrad on copper, silver, gold, and uranium targets. The results confirm the predictions of quantum electrodynamics, if the exchange of a very large number of photons with the nucleus (Coulomb correction) is taken into account. At momentum transfers of a few MeV/c, the Coulomb correction for uranium results in a reduction of the cross section by a factor between 3 and 5 as compared to the prediction of lowest-order relativistic perturbation theory. The photon-splitting process has been experimentally detected at the same energies and angles. Estimates of the cross section are given. (auth)

28268 E1 DECAY FROM ISOBARIC ANALOG RESONANCES STUDIED IN PROTON CAPTURE. Paul, P. (State Univ. of New York, Stony Brook). Kakuriken Kenkyu Hokoku; 5: 343-358 (1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

Data on E1 single-particle (sp) transitions from isobaric analog states (IAS) obtained by proton radiative capture are discussed. The discussion is restricted to those IAS for which parameters are well established. Excitation functions for ^{208}Pb and ^{209}Bi targets are given, and E1 strength parameters obtained for transitions in ^{209}Bi are tabulated. E1 transitions from the $2d_{\frac{5}{2}}$, $3s_{\frac{1}{2}}$, and $2d_{\frac{3}{2}}$ IAR in ^{87,89}Y and ^{91}Nb are discussed. All transitions from the $2d_{\frac{5}{2}}$ IAS in ^{87}Y and ^{89}Y display a lack of depletion. Excitation functions for proton capture in ^{86,88}Sr are shown. In summary, there is consistent evidence that simple E1 transitions are systematically hindered, and no evidence that spin-flip E1 transitions behave differently in this respect. However, certain states show a lack of hindrance, or even show enhancement, in all their transitions; this finding thus seems to be related to a property of the initial state rather than of the transition matrix elements. If only those states with unambiguous properties are considered, the observed hindrance of the sp transitions can be explained by admixtures of collective E1 states into the initial and final states. (8 figures, 4 tables) (RWR)

28269 GAMMA RAYS FOLLOWING NEUTRON INELASTIC SCATTERING IN ^{165}Ho AND ^{89}Y. Haider, Y. (Dacca Univ., India); Arefin, S.; Siddiq, A. K. M.; Hosn-Ara-Begum; Dutt, J. C. Nucl. Sci. Appl., Ser. B; 6: 32-36(Oct 1973).

Some energy levels in ^{165}Ho and ^{89}Y below 2 MeV were observed by measuring de-excitation gamma rays from (n,n'γ) scattering process. Levels at 362 ± 3, 510 ± 4 and 710 ± 6 KeV in ^{165}Ho and at 910 ± 7 and 1530 ± 12 KeV in ^{89}Y were clearly identified. The protons accelerated from Dacca 3 MeV Van de Graaff Accelerator were used. Neutrons were obtained by T (p,n) ^{3}He reaction. (auth)

28270 RELATIVE YIELDS OF SOME PHOTO-NUCLEAR REACTIONS AT HIGH ENERGY. Ahmad, G. (Bangladesh Univ. of Engineering and Tech., Dacca, India). Nucl. Sci. Appl., Ser. B; 6: 28-31(Oct 1973).

Thin discs of polythene, copper and zinc were exposed to the bremsstrahlung beam of Glasgow University 322 MeV electron

Synchrotron. The end point energy of the bremsstrahlung beam was varied from 100 to 322 MeV. The relative rates of production of $^{64}Zn(\gamma,n)^{63}Zn$, $^{64}Zn(\gamma,2n)^{62}Zn$, $^{64}Zn(\gamma,p2n)^{61}Cu$, $^{63}Cu(\gamma,n)^{62}Cu$, $^{63}Cu(\gamma,2n)^{61}Cu$, $^{65}Cu(\gamma,n)^{64}Cu$ and $^{12}C(\gamma,n)^{11}C$ reactions were obtained from the decay curves of the annihilation radiation. (auth)

28271 INTERMEDIATE STRUCTURE IN ISOBARIC ANALOGUE RESONANCES. Petrascu, M. (Inst. for Atomic Physics, Bucharest). pp 240-266 of Proceedings of the Europhysics Study Conference on Intermediate Processes in Nuclear Reactions. Cindro, N. (ed.). New York; Springer-Verlag (1973).

From proceedings of the europhysics study conference on intermediate processes in nuclear reactions; Plitvice Lakes, Yugoslavia (31 Aug 1972). See CONF-720863-.

Topics relevant to the subject of isobaric analog resonances (IAR) as intermediate structure are considered. "Gross structure of isobaric analog resonances as intermediate structure" considers the fine structure enhancement in the vicinity of the IAR: an outline of theoretical work on fine structure enhancement and recent experimental results on proton reactions with Ge are given. "Substructures in isobaric analog resonances" discusses recent experimental results on ^{70}Ge and ^{66}Zn, which in some cases indicate the presence of substructures (different from the fine structure) within the IAR gross structure. It was concluded that there exists evidence concerning substructure within the range of the gross structure of IAR, and that these substructures are not compound-nucleus fine structure; that these substructures cannot be explained by the presence of other parent states; that these substructures cannot be interpreted as Ericson fluctuations; and that a possible interpretation of the inelastic data can be given in terms of coupling of hallway states with configurations in the residual nucleus due to their simplicity, and that this, together with the structure in elastic scattering, can be regarded as support for the doorway-hallway picture of nuclear reactions. (13 figures, 2 tables) (RWR)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 27764, 27813, 28179, 28185, 28229, 28232, 28239, 28246, 28249, 28251-28253, 28255, 28258, 28259, 28261, 28266-28268, 28307, and 28335.

28272 (INIS-mf-1114) SOME APPLICATIONS OF A CURVED-CRYSTAL SPECTROMETER IN NUCLEAR PHYSICS. van Eijk, C. W. E. (Technische Hogeschool Delft (Netherlands)). 26 Sep 1973. 99p. INIS.

A small curved-crystal spectrometer for the detection of x-rays and gamma rays built at the Technical University is described. The spectrometer is of the transmission type and is operated in the DuMond arrangement. A framework was chosen in which the crystal is rotated about a fixed vertical axis. The source is moved horizontally and rectilinearly in the beam direction. The arm on which the detector is mounted, is moved in a horizontal plane over twice the angle of rotation of the curved crystal. The energy range of the spectrometer is from 10 to 400 keV. The efficiency of the spectrometer varies from about 10^{-5} at 20 keV to 10^{-6} at 400 keV. Applications of the spectrometer include a study of the decay of ^{99}Mo. The crystal spectrometer, Ge(Li) detectors, a beta-ray spectrometer and a fast coincidence arrangement were employed. Gamma ray energies and intensities and some internal conversion coefficients were measured. The level scheme of ^{99}Tc was deduced and spin and parity assignments were made. The measurements of isotopic shifts of the $K\alpha_1$ X-rays of ^{162}Dy-^{164}Dy and ^{140}Ce-^{142}Ce, respectively, are described. From the results $\Delta E = (58.1 \pm 3.3)$ meV (Dy) and ΔE (51.4 ± 1.9) meV (Ce), we obtained the differences in the mean square nuclear charge radii of above mentioned isotopes: $\Delta\langle r^2\rangle = (0.136 \pm 0.008)$ fm^2 and (0.274 ± 0.010) fm^2, respectively. These values were used to normalize optical isotopic shift data. The differences in the charge radii of all stable Dy and Ce isotopes could be determined. The K-shell auto-ionization probability in the β^--decay of ^{143}Pr is measured applying a new method. A value of $(2.88 \pm 0.20)\ 10^{-4}$ was obtained for the number of K-shell vacancies per β^--decay. This result is compared with previous results and with theory. (INIS)

28273 (IS-T-604) DECAYS OF ^{139}Xe AND ^{139}Cs. Lee, M. A. (Ames Lab., Iowa (USA)). Feb 1974. Contract W-7405-eng-82. 164p. Dep. NTIS $11.25.

Thesis.

Sources of ^{139}Xe and ^{139}Cs were produced at the TRISTAN on-line isotope separator. With the aid of Ge(Li) singles and Ge(Li)-Ge(Li) coincidence measurements, level schemes were constructed for ^{139}Cs and ^{139}Ba. In the ^{139}Cs level scheme 193 of 220 observed transitions, constituting more than 98% of the gamma-ray intensity, were placed among 50 excited levels. In the ^{139}Ba level scheme there are 62 excited levels, among which are placed 161 of 177 observed gamma-ray transitions. These transitions account for more than 98% of the observed gamma-ray intensity. The Q values for the beta decays of ^{139}Xe and ^{139}Cs were measured by using a Ge(Li)-plastic scintillator coincidence arrangement. For ^{139}Xe the measured Q value is 4.88 ± 0.06 MeV, and for ^{139}Cs the measured Q value is 4.29 ± 0.07 MeV. Spin and parity assignments were made with the help of calculated log-ft values and angular momentum transfer in stripping reactions, where available. An attempt was made to interpret some of the levels in terms of the shell model. (18 figures, 11 tables) (auth)

28274 (IS-T-619) FIVE-PARTICLE, SHELL-MODEL CALCULATION USING A SPIN-DEPENDENT POTENTIAL AS APPLIED TO ^{101}Tc AND THE NUCLEAR DECAYS OF ^{101}Mo, ^{101}Tc, ^{142}Xe, AND ^{142}Cs. Wright, J. F. (Ames Lab., Iowa (USA)). Mar 1974. Contract W-7405-eng-82. 117p. Dep. NTIS $9.00.

Thesis.

Five-particle shell-model calculations, using a spin-dependent potential, were performed for the nucleus ^{101}Tc. The effects of varying the single-particle energy differences and the strengths of the spin-dependent and pairing terms are discussed. The isobars ^{101}Mo and ^{101}Tc were chemically separated to enable the detailed study of their decay schemes. As a result, 184 gamma rays were observed in the decay of ^{101}Mo, and 169 of them were assigned to 45 levels in ^{101}Tc. In the decay of ^{101}Tc, 27 gamma rays were observed, and 26 of them were assigned to 11 levels in ^{101}Ru. In a study of the decays of ^{142}Xe and ^{142}Cs the TRISTAN on-line isotope separator was used to separate the 142 mass chain produced in ^{235}U fission with ^{142}Xe as the emanating and accelerated nuclide. Isobaric separation of ^{142}Xe and ^{142}Cs was achieved with a moving tape system. In the ^{142}Xe decay, 146 gamma rays were observed, and 112 of them were assigned to 32 levels in ^{142}Cs. Similarly, 113 gamma rays were observed in the ^{142}Cs decay, and 58 of them were placed in 26 levels in ^{142}Ba. Nuclear spins and parities were assigned to some of the experimental levels, and are discussed in relation to nuclear models and systematics. (18 figures, 16 tables) (auth)

28275 (IS-T-620) LIFETIMES OF NUCLEAR LEVELS IN THE DECAYS OF SOME MASS-SEPARATED FISSION PRODUCTS. Morman, J. A. (Ames Lab., Iowa (USA)). Mar 1974. Contract W-7405-eng-82. 93p. Dep. NTIS $7.75.

Thesis.

The nuclei ^{141}Cs, ^{140}Cs, and ^{136}Xe were examined for the presence of energy levels with measurable half-lives in the nanosecond range. The lifetime measurement system is described along with the least-squares fitting procedure developed to analyze the data. In ^{141}Cs, two energy-level half-lives were measured: the 69-keV level with a half-life of 23.3 ± 0.7 ns, and the 106-keV level with a half-life of 8.7 ± 0.2 ns. ^{140}Cs has three levels whose half-lives were measured: the 14-keV level, 471 ± 51 ns; the 65-keV level, 3.7 ± 0.3 ns; and the 103-keV level, 7.2 ± 0.5 ns. No levels in ^{136}Xe were found to have half-lives within the measuring range of the equipment. Also, for each nucleus, upper limits for the half-lives of other levels are given. The results are compared with the theoretical predictions for the lifetimes, and the possible multipolarities of the transitions are discussed. (30 figures, 6 tables) (auth)

28276 (JINR-P4-7695) ISOMERIC SHIFT OF X-RAY LINES. Ignaovich, V. K.; Ostanevich, Yu. M.; Panteleev, Ts. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 16p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

The possibility of measuring nuclear deformation under excitation by means of atomic x-ray line shift is considered. The value of the expected effect is estimated with the help of the numerical data published. (auth)

28277 (JINR-P6-7716) NEW EMITTERS OF DELAYED PROTONS ^{119}Ba, ^{121}Ba, AND ^{123}Cs. Bogdanov, D. D.; Dem'yanov, A. V.; Karnaukhov, V. A.; Petrov, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

New delayed-proton emitters ^{123}Cs, ^{119}Ba, and ^{121}Ba were identified in the reactions Zr + ^{32}S and ^{92}Mo + ^{32}S by the on-line isotope separator BEMS-2. The half-lives and the proton energy spectra were measured. For ^{123}Cs the results are $T_{\frac{1}{2}} = (3.9 \pm 0.4)$ s and the proton spectrum covers the energy range from 2.0 MeV up to 6.5 MeV, for ^{119}Ba $T_{\frac{1}{2}} = (5.35 \pm 0.30)$ s and $E_p = 2.0$ to 6.0 MeV, for ^{121}Ba $T_{\frac{1}{2}} = (29.7 \pm 1.5)$ s and $E_p = 2.0$ to 4.0 MeV. The proton branching ratios for ^{123}Cs and ^{121}Ba were measured to be equal to $(3 \pm 1) \times 10^{-3}$ and $\approx 2.5 \times 10^{-4}$, respectively. (5 figures) (auth)

28278 (JINR-P6-7761) NEW ISOTOPE ^{132}Pr($T_{½}$ = 1.6 ± 0.3 MIN.). Arlt, R.; Gromov, K. Ya.; Latuszynski, A.; Ortlepp, H. G.; Yasinski, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 8p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

A new isotope ^{132}Pr was found. Its half-life was found to be $T_{½}$ = (1.6 ± 0.3) min. (auth)

28279 (KFK-1768) SYSTEMATIC EXPERIMENTS ON NEUTRON DEFICIENT NUCLEI IN THE REGION 50 ≤ (N,Z) ≤ 82. van Klinken, J.; Habs, D.; Klewe-Nebenius, H.; Wisshak, K.; Nowicki, G.; Buschmann, J.; Goering, S.; Loehken, R.; Reble, H.; Schatz, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Zyklotron-Lab.). Nov 1973. 110p. Dep. NTIS (U. S. Sales Only) $8.50.

Basic data on half-lives, partial decay schemes and isomerism were obtained for several adjacent nuclei in the neutron deficient region with 58 < Z ≤ 64. Single spectra of γ-rays and conversion electrons, as well as γγ-coincidences were measured for the (α, xn + yp + zα)-reaction products of enriched targets of ^{144}Sm, ^{142}Nd, ^{141}Pr, ^{140}Ce, ^{138}Ce, ^{136}Ce and ^{139}La. For several new radioisotopes (partial) decay schemes were constructed using a set of general rules for nuclidic-, level-, and spin assignments. Detailed discussions are presented for: ^{144}Gd(4.4 min), ^{143m,g}Sm(30 ms), ^{143}Gd(1.9 min), ^{142m}Pm(2.38 ms), ^{142g}Eu(≤30 s), ^{142m}Eu(1.2 m), ^{142}Gd(1.5 min), ^{141g}Sm(11 min), ^{141g}Eu(28 s), ^{141m}Eu(~7 s), ^{140g}Pm (9.2 s), ^{140}Sm(14.7 min), ^{140}Eu(20 s), ^{139g}Pm(4 min), ^{139m}Pm(0.5 s), ^{139g}Sm(2.6 min), ^{138}Pm(3.5 min), ^{137g}Nd(38 min), ^{137}Pm(2.4 min) and ^{135}Nd(12 min). (auth)

28280 (USNDC-9, pp 2-5) EVALUATION OF DECAY-SCHEME DATA. Helmer, R. G.; Greenwood, R. C. (Aerojet Nuclear Co., Idaho Falls, ID). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28-29, 1973.

28281 (USNDC-9, pp 6-8) INTEGRAL CROSS SECTION MEASUREMENTS. Harker, Y. D. (Aerojet Nuclear Co., Idaho Falls, ID). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28-29, 1973.

28282 (USNDC-9, pp 59; 60-61) ^{135}Ba(n,γ)^{136}Ba. Rimawi, K.; Wasson, O. A.; Chrien, R. E. (Brookhaven National Lab., Upton, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28-29, 1973.

28283 LOW-LYING LEVELS OF ^{140}Pr. Hussein, S. G.; Sanderson, N. E.; Summers-Gill, R. G. (McMaster Univ., Hamilton, Ont.). Nucl. Phys., A219: No. 2, 407-421(1974).

The doubly odd nucleus ^{140}Pr was investigated by means of the ^{141}Pr(d,t)^{140}Pr and ^{140}Ce(p,nγ)^{140}Pr reactions. Twenty-eight levels, up to 1300 keV excitation, were observed in the pickup study. DWBA analysis was used to determine l-values and spectroscopic factors for all but a few which are very weakly populated. Gamma-ray angular distributions, measured at E_p = 4.78 MeV for the five strongest γ-rays, show appreciable nuclear alignment and demonstrate the feasibility of such experiments in this mass region. Taken together, the two studies have permitted the identification of the 12 levels expected from the low-lying $(\pi 2d_{5/2}\nu 2d_{5/2}^{-1})$, $(\pi 2d_{5/2}\nu 3s_{1/2}^{-1})$, $(\pi 1g_{7/2}\nu 2d_{5/2}^{-1})$ and $(\pi 1g_{7/2}\nu 3s_{1/2}^{-1})$ configurations. Tentative spin assignments for the strong odd-parity states are suggested on the basis of their spectroscopic factors. (auth)

28284 MAGNETIC DIPOLE MOMENTS OF DOUBLY ODD ANTIMONY ISOTOPES WITH $(h_{11/2})_n$ NEUTRON CONFIGURATION. Callaghan, P. T.; Shott, M.; Stone, N. J. (Oxford Univ.). Nucl. Phys., A221: No. 1, 1-12(1974).

The half-life, g-factor and spin of the ^{122m}Sb ground state were measured using the technique of NMR/ON to be 5.00 ± 0.01 h, 0.290 ± 0.005 n.m. and 8 respectively. The ground state spin of ^{120m}Sb was also determined as 8. A more accurate measurement of the hyperfine field at Sb in Fe yields new values for the moments of ^{122m}Sb, ^{124}Sb and ^{126}Sb. A model including configuration mixing and collective effects is used to interpret the moments of those doubly odd isotopes from ^{116m}Sb to ^{126}Sb, whose odd neutron is $(h_{11/2})$. (auth)

28285 DETERMINATION OF THE STATIC QUADRUPOLE MOMENT OF THE FIRST 2$^+$ STATES OF ^{122}Te, ^{124}Te, and ^{130}Te BY HEAVY-ION COULOMB EXCITATION. Larsen, R. D.; Lutz, W. R.; Ragland, T. V.; Scharenberg, R. P. (Purdue Univ., Lafayette, IN). Nucl. Phys., A221: No. 1, 26-36(1974).

A Coulomb excitation experiment was performed on the first 2$^+$ states of ^{122}Te, ^{124}Te and ^{130}Te. The relative excitation probabilities of the first 2$^+$ states were measured at backward and forward projectile scattering angles. Particle-γ coincidences were used to identify the inelastic events. The data were analyzed with the aid of the Winther-deBoer multiple Coulomb excitation program. Separate γ-ray angular distribution measurements were made as a function of target recoil velocity to determine the influence of the deorientation effect. The projectile and bombarding energy were chosen to minimize the effect on the experiment of higher state interference due to Coulomb excitation of the first 2$^+$ state via the second 2$^+$ state. For positive higher state interference the extracted quadrupole moments of the first 2$^+$ states are Q_{2^+} = −0.43 ± 0.08 B, −0.49 ± 0.08 b and −0.08 ± 0.08 b for ^{122}Te, ^{124}Te and ^{130}Te respectively. These results and other measurements of Q_{2^+} for the doubly even Te isotopes are used to discuss the model dependent calculations of Q_{2^+}. (auth)

28286 STRUCTURE OF ^{58,59,60}Ni NUCLEI FROM THE (p,t) REACTION. Kong-A-Siou, D. H.; Cole, A. J.; Giorni, A.; Longequeue, J. P. (Institut de Sciences Nucleaires, Grenoble, France). Nucl. Phys., A221: No. 1, 45-59(1974). (In French).

^{60,62}Ni(p,t)^{58,60}Ni experiments were undertaken at 46.5 MeV. More than twenty new levels are identified with J^π, T assignments. The angular distributions obtained are analyzed using zero range DWBA calculations in which the usual Hankel function is replaced at the nuclear surface by a dineutron wave function calculated in a Saxon-Woods potential. Level structure information is obtained from comparison with other experiments. (auth)

28287 SPINS OF THE LEVELS AND MULTIPOLE MIXING RATIOS OF TRANSITIONS IN ^{125}Sb DETERMINED FROM γ−γ DIRECTIONAL CORRELATION AND POLARIZATION−DIRECTIONAL CORRELATION MEASUREMENTS. Garber, D. A.; Behar, M.; Grabowski, Z. W.; Yu, Y. W. (Purdue Univ., Lafayette, IN). Nucl. Phys., A219: No. 2, 370-380(1974).

In order to resolve several discrepancies in spin assignments to levels in ^{125}Sb, directional correlations and polarization-directional correlations were measured for several γ−γ cascades in ^{125}Sb populated from the decay of ^{125}Sn. Earlier results obtained from using NaI and Ge(Li) and NaI detectors were difficult to interpret due to the complex structure of the decay scheme. To improve the experimental situation, two coaxial Ge(Li) detectors were used for the angular correlation measurements and a coaxial Ge(Li)-planar Ge(Li) combination for the polarization-directional correlations. Combination of the results of these measurements give unique spin assignments of $1^1/_2^-$, $1^1/_2^-$, $^3/_2^+$, $1^1/_2^+$ and $^3/_2^+$ to the 1982 keV, 1890 keV, 1420 keV, 1089 keV and 1067 keV levels, respectively. The determined E2/M1 mixing ratios are: δ(470) = 0.010 ± 0.027, δ(1067) = −0.86 ± 0.18, and δ(916) = −0.02 ± 0.01. (auth)

28288 LEVELS IN ^{105}Ru POPULATED IN THERMAL NEUTRON CAPTURE. Hrastnik, B.; Seyfarth, H.; Hassan, A. M.; Delang, W.; Goettel, P. (Kernforschungsanlage, Juelich, Ger.). Nucl. Phys., A219: No. 2, 381-396(1974).

The ^{104}Ru(n,γ) reaction was studied through singles and coincidence γ-ray spectroscopy and angular correlation measurements. A level scheme with 34 states and spin and parity assignments for most of these was deduced from the present data and the l-values from a previous (d,p) study. The neutron binding energy was determined as 5909.9 ± 0.5 keV, implying that the lowest observed (d,p) state corresponds to the 20.5 keV $^5/_2^+$ isomeric state. A comparison of the level scheme with the Nilsson scheme and the de-Shalit model with effective interactions explains the $^3/_2^+$ ground state and the $^1/_2^+$ isomeric state, but does not provide evidence for strong deformation of this nucleus. (auth)

28289 MAGNETIC MOMENT OF THE $1h_{11/2}$ SINGLE-PROTON STATE IN ^{141}Pr. Ejiri, H.; Shibata, T.; Takeda, M. (Osaka Univ.). Nucl. Phys., A221: No. 1, 211-220(1974).

A magnetic dipole core polarization was studied by investigating a magnetic moment of the 1117 keV $1h_{11/2}$ single-proton state in ^{141}Pr. The ^{139}La(α,2nγ)^{141}Pr reaction was used to populate $1h_{11/2}$ state with spin aligned in a plane perpendicular to the beam axis. The magnetic moment was obtained by measuring perturbed angular distributions of the 972 keV gamma rays from the $1h_{11/2}$ state. The g-factor of the $1h_{11/2}$ state in ^{141}Pr was determined to be g = 1.30 ± 0.08. The isovector spin g-factor was deduced from the present result and the data for $1h_{11/2}$ neutron states. It is $g_{s=1}^{eff}/g_{s=1}^{free}$ = 0.45 ± 0.1. The reduction is explained in terms of a spin-isospin (M1) core polarization. The isovector M1 core polarization factor (nuclear M1 susceptibility) is found to be one third of the M2 core polarization factor (nuclear M2 susceptibility) for the $1h_{11/2}$ state. (auth)

28290 DISTRIBUTION OF DIPOLE AND SPIN-DIPOLE STRENGTH IN NUCLEI. Harvey, M.; Khanna, F. C. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Phys., A221: No. 1, 77-92(1974).

The schematic model of Goswami and Pal is applied to heavy nuclei and the dipole strength is shown to reside in just four nondegenerate levels. The collection of all the strength into a single level is discussed. The distribution of strength due to nonconstancy of radial integrals and nondegeneracy of unperturbed particle-hole orbits is demonstrated in "realistic" calculations for ^{208}Pb, ^{132}Sn, ^{90}Zr and ^{56}Ni. The collection of low energy dipole strength into "mini-resonances" is shown to be sensitive to the mean energy difference between neutron and proton particle-hole states. (auth)

28291 MAGNETIC MOMENT OF THE 2$^-$ STATE IN ^{92}Nb. Leitz, W.; Recknagel, E.; Sielemann, R.; Wichert, T. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Phys.; A221: No. 2, 319-324(1974).

The g factor of the $[\pi(2p_{\frac{1}{2}})^1\nu(2d_{\frac{5}{2}})^1]_{2^-}$ state in ^{92}Nb(τ = 6.2 μs) was determined by means of perturbed angular distribution methods using the ^{92}Zr(p,n)^{92}Nb reaction in a liquid alloy. The $\nu(d_{\frac{5}{2}})$ magnetic moment extracted is discussed in terms of the core-polarization effect. (3 figures, 1 table) (auth)

28292 LIFETIMES IN ^{103}Rh, ^{107}Ag, AND ^{109}Ag MEASURED BY THE RECOIL-DISTANCE TECHNIQUE. Miller, T. R.; Takeda, M. (Stanford Univ., CA). Nucl. Phys.; A221: No. 2, 392-402 (1974).

The lifetimes of the lowest $\frac{7}{2}^+$ and $\frac{5}{2}^+$ levels in ^{103}Rh, ^{107}Ag and ^{109}Ag were measured with the Doppler-shift version of the recoil-distance technique. A beam of ^{35}Cl ions of energy 64 MeV was used to Coulomb excite the target nuclei and eject them from the target. The following lifetimes were obtained: τ(^{103}Rh, $\frac{7}{2}^+$, 295 keV) = 14.5 ± 1.5 ps, τ(^{103}Rh, $\frac{5}{2}^+$, 357 keV) = 112 ± 10 ps; τ(^{107}Ag, $\frac{7}{2}^+$, 325 keV) = 7.2 ± 1.3 ps, τ(^{107}Ag, $\frac{5}{2}^+$, 423 keV) = 43 ± 3 ps; τ(^{109}Ag, $\frac{7}{2}^+$, 311 keV) = 8.5 ± 1.0 ps, τ(^{109}Ag, $\frac{5}{2}^+$, 415 keV) = 50 ± 3 ps. Of the several correction factors taken into account, the perturbation of the γ-ray angular distribution by the magnetic hyperfine interaction during recoil through vacuum was found to give the largest correction to the measured lifetimes. These lifetimes lead to reduced transition probabilities B_d(E2) for the silver nuclei in reasonable agreement with the predictions of the core-excitation theory. (5 figures, 2 tables) (auth)

28293 DECAY OF ^{116m}In(T = 54 MIN). Ardisson, G. (Univ., Algiers). Radiochem. Radioanal. Lett.; 16: No. 5, 241-248 (15 Feb 1974). (In French).

Radioactive decay of ^{116m}In was reinvestigated with different size coaxial Ge(Li) detectors. Energies and intensities of forty γ-rays were measured. Twelve were reported for the first time. In ^{116}Sn a 3005-keV new level is suggested. Tentative levels of 2701, 2545, and 2029 keV seem to be fed in this decay. (auth)

28294 EXPERIMENTAL EVIDENCE FOR A DECAY MODE OF HIGHLY EXCITED $T_>$ LEVELS. Whitten, C.A. Jr.; Chai, J.; Dunlop, W.H.; Igo, G.J.; Kulleck, J.G. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. Lett. 31: No. 18, 1143-1146 (29 Oct 1973).

In the bombardment of ^{96}Mo by proton beams with energies between 22 and 28 MeV, a definite structure is observed in the proton spectra of the reaction products, extending from about 3.0 to 4.2 MeV. The characteristics of this structure indicate that it arises from the isospin-allowed two-neutron decay (experimentally unobserved) of T > (T = 13/2) levels in ^{97}Tc to low-lying T > (T = 11/2)^{95}Tc levels which then undergo proton decay (experimentally observed) to the low-lying levels of ^{94}Mo. The ^{97}Tc levels whose decay modes produce this structure have excitation energies between 27 and 33 MeV and they are from 16 to 22 MeV above the lowest-lying $T_>$ state in ^{97}Tc. (auth)

28295 QUADRUPOLE MOMENTS OF THE FIRST 2$^+$ STATES OF ^{106}Cd AND ^{108}Cd. Hall, I.; Nolan, M. F.; Thomas, D. J.; Throop, M. J. (Univ. of Liverpool). J. Phys., A (London); 7: No. 1, 50-57(1 Jan 1974).

The static electric quadrupole moments of the first 2$^+$ states of ^{106,108}Cd were measured by Coulomb excitation. The measured moments are significantly smaller than previously reported values and indicate a gradual change in quadrupole moment across both the isotopes of Cd and the N = 58 and 60 isotones. (auth)

28296 INTERFACING AN ANALOGUE PLOTTER TO A NUCLEAR DATA ACQUISITION AND PROCESSING SYSTEM OF NUCLEAR DATA 50/50 TYPE. Lokos, S. ATOMKI (At. Kut. Intez.) Kozlem.; 15: No. 2, 95-105(1973). (In Hungarian).

An analog plotter, type NE 230, manufactured by EFKI, was interfaced to a Nuclear Data 50/50 system. The principle of operation and some circuits of the interface are given. The plotter uses the following device codes of the PDP-8/T small computer: 50, 51 and 52. The interface unit is apt to decode and perform 8 instructions, the status of the plotter is monitored using three flags. The high speed, accurate digital-analogue converters ensure a wide range of applications for the interface. (auth)

28297 TRANSITION CHARGE DENSITY OF VIBRATIONAL NUCLEI. Hosoyama, K.; Torizuka, Y.; Kawazoe, Y.; Ui, H. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 5: 139-144 (1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The transition charge densities leading to the first excited states of palladium-106, cadmium-114, and tin-116 and -120 are determined from the differential cross sections of the inelastic electron scattering at 183 and 250 MeV. Further analysis is performed of the differential cross sections leading to the first and second 2$^+$ states of palladium-106 and cadmium-114 based on the anharmonic vibrator model with nonuniform charge density. Using this model the values of the static quadrupole moments of the first excited states are calculated. (JFP)

28298 NUCLEAR SCATTERING OF PLANE-POLARIZED PHOTONS. Barber, W. C. (Massachusetts Inst. of Tech., Cambridge); Hayward, E.; Sazama, J. Kakuriken Kenkyu Hokoku; 5: 313-317(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The scattering of 15.1-MeV plane-polarized photons from cadmium, tin, tantalum, gold-197, and bismuth-209 was measured for the purpose of studying the coupling of the giant dipole resonance to the low lying vibrational states. The motivation was to check the basic idea of the dynamic collective model and if possible to obtain some quantitative data that can be useful in refining that description. An attempt is made to separate the different components in the scattering cross section not according to the energies of the deexcitation gamma rays, but according to the angular momentum transferred to the nucleus in the two-step scattering process. The differential cross sections are found. (JFP)

28299 ISOTOPIC MIXING IN THE ISOBARIC ANALOG STATES OF ^{90}Zr. Askin, H. J.; Allen, J. K. F.; Hicks, R.; Petty, R. J.; Thompson, M. N. (Univ. of Melbourne, Parkville, Australia). Kakuriken Kenkyu Hokoku; 5: 359-366(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The results of three experiments to study isospin splitting in ^{90}Zr are reported. The photoproton energy spectrum, the total photoneutron cross section, and the neutron spectrum to the first T = $1\frac{1}{2}$ state in ^{89}Zr were measured with bremsstrahlung between 14 and 29 MeV. Evidence was found for correlations between the isotopic analog states detected in the photoproton spectrum and structure observed in the total photoneutron cross section; this implies that there is significant isospin mixing in the states below 20 MeV. A quantitative estimate of the mixing coefficient was not possible. Evidence for a T = 6 state at about 22 MeV was found in a photoneutron spectrum measurement, along with some indications of further $T_>$ strength above 22 MeV. Fair agreement with theoretical calculations was seen. (4 figures, 1 table) (RWR)

28300 RECENT ELECTRON SCATTERING EXPERIMENTS AT AMSTERDAM. de Vries, C. (Inst. for Nuclear Physics Research, Amsterdam). Kakuriken Kenkyu Hokoku; 5: 405-415 (1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

Experimental research on electron reactions is summarized. Only the most interesting aspects are discussed. (JFP)

28301 MAGNETIC MOMENT OF THE 828 keV LEVEL IN ^{115}In. Badica, T.; Ciortea, C.; Dima, S.; Gelberg, A.; Petrovici, A.; Popescu, I. (Inst. for Atomic Physics, Bucharest). Nucl. Phys.; A222: No. 1, 168-172(1974).

The magnetic moment of the 828-keV level in ^{115}In was found to be 0.80 ± 0.14 μ_N by measuring the γ-γ integral angular correlation perturbed by an external magnetic field. Several assumptions concerning the nature of the state investigated are discussed. (3 figures) (auth)

28302 POLARIZATION MEASUREMENTS AND OPTICAL MODEL ANALYSES OF NEUTRON SCATTERING AT 3.2 MeV. Zijp, E.; Jonker, C. C. (Vrije Univ., Amsterdam). Nucl. Phys.; A222: No. 1, 93-116(1974).

Angular distributions of the polarization analyzing powers were measured for elastic scattering of 3.2-MeV neutrons on 20 elements from titanium to bismuth. The results were compared with optical-model predictions using known global potentials and allowing for the compound elastic scattering by Hauser–Feshbach calculations. None of these potentials gave a good description for all elements. But even with individual analyses no satisfactory description could be obtained; in particular, the description of the polarization together with known cross-section data gave no consistent parameter sets. It is shown by coupled-channel calculations with a nonspherical optical model that the influence of the direct excitation of low-lying levels on the elastic scattering is very large and can explain the difficulties encountered in the spherical optical-model analyses. (11 figures, 12 tables) (auth)

28303 STUDY OF NUCLEAR SPALLATION BY COUNTERS AND MAGNETIC ANALYSIS. pp 143-166 of Yadernye Reaktsii pri Vysokikh Energiyakh. Denisov, F. P. (ed). Moscow; Atomizdat (1972). (In Russian).

A review is given of studies of secondary particles (p, d, n, α, t, and ^{3}He) formed in nuclear reactions during bombardment with high-energy particles (p, n, d, and α) of natural element targets from Li to U. Solid or gaseous targets were irradiated with particle beams at energies of E_p = 100 MeV to 70 GeV, E_n = 90 to 380 MeV, E_d = 190 to 320 MeV, and E_α = 375 MeV. The relative yields, angular distributions, and energy spectra of the secondary protons, neutrons, and deuterons were reported. The dependence of the yield on the atomic number and mass number of the target element was traced. The detection of the secondary particles was accomplished by scintillation chambers, Wilson chambers in a magnetic field, Bi fission chambers, and proportional counters. Spark chambers and the time-of-flight method were used for the study of fragments in tests with proton beams at E_p = 30 to 70 GeV. (tr-auth)

28304 DECAY OF ^{125}Sb. Subba Rao, K. (Regional Engineering Coll., Warangal, India); Ila, P.; Sudhakar, K.; Narashimham, K. L.; Lakshminarayana, V. Curr. Sci. (India); 43: No. 6, 176-177(20 Mar 1974).

A search was made for the seven disputed gamma rays in the level structure of technetium-125 from the decay of antimony-125. The relative intensities of the gamma rays are listed. (JFP)

28305 RADIOACTIVE-DECAY GAMMAS: ORDERED BY ENERGY AND NUCLIDE. Bowman, W. W.; MacMurdo, K. W. (E. I. du Pont de Nemours and Co., Aiken, SC). Contract AT(07-2)-1. At. Data Nucl. Data Tables; 13: No. 2-3, 89-292(Feb 1974).

Presented here is a two-part catalog of gamma rays emitted by nuclides in radioactive decay. The first part lists the gamma rays in order of increasing energy. The first section of this part covers nuclides with half-life less than one day. The second section covers nuclides with half-life greater than one day, and includes all naturally-occurring radionuclides regardless of length of half-life. Each listing consists of gamma-ray energy and uncertainty, abundance, half-life, production mode, and the energies of two of the more abundant associated gamma rays. The second part of the catalog lists up to 50 of the more abundant gamma rays for each nuclide. The listing for each nuclide includes half-life, production mode, possible genetic relationships, and references. The listing is followed by the energy, uncertainty in energy, and abundance of each gamma ray. The catalog was designed for analytical gamma-ray spectrometry by semi-conductor detector. References available through May 1973 are covered. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 28229, 28232, 28252, 28253, 28261, 28269, 28276, 28281, 28298, and 28302.

28306 (CEA-N-1662) MEASUREMENT OF THE NEUTRON RADIATIVE CAPTURE CROSS SECTION OF Au BETWEEN 75 AND 550 keV. Le Rigoleur, C.; Arnaud, A.; Taste, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13–Saint-Paul-les-Durance (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees). Aug 1973. 32p. (In French). Dep. NTIS (U. S. Sales Only) $4.75.

The absolute values of the neutron radiative capture cross sections of Au were determined between 75 and 550 keV. The γ radiation produced by the cascade was detected with a liquid scintillator. A ^{10}BNaI(TL) detector of well known efficiency was employed to measure the neutron flux. Time-of-flight techniques were used in conjunction with an on-line computer. (auth)

28307 (COO-3427-6, pp 36-39) SEARCH FOR NATURAL ALPHA INSTABILITY. 1973.

In nuclear chemistry research.

28308 (FRNC-TH-412) STUDY OF THE α DECAY CHARACTERISTICS OF LIGHT Bi AND Pb ISOTOPES. Production and identification of New Nuclei ^{188}Bi, ^{187}Pb, and ^{186}Pb. Livet, J. (Paris-5 Univ., 75 (France)). 1973. 86p. (In French). Dep. NTIS (U. S. Sales Only) $7.50.

Thesis.

Beams of ^{40}Ar ions (302 MeV, 5×10^{12} particles/second) and ^{3}He ions (210 MeV, 10^{11} particles/second) were used to bombard ^{155}Gd and ^{159}Tb, and ^{203}Tl targets, respectively. In this way, new highly neutron deficient α-emitting Pb and Bi isotopes were formed. The reactions ^{159}Tb(^{40}Ar,xn)$^{199-x}$Bi and ^{203}Tl(^{3}He,xn)$^{206-x}$Bi were used to identify ^{189,190,191,192,193,196,197}Bi isotopes, and the reaction ^{155}Gd(^{40}Ar,xn)$^{195-x}$Pb was used to identify ^{186,187,188,189,190}Pb isotopes. The ^{188}Bi, ^{187}Pb and ^{186}Pb isotopes were hitherto totally unknown. The other isotopes have never appeared in any official publication, although they have already been mentioned. The lifetimes of most of the nuclei obtained is less than one minute, the collection of which must be effected rapidly. The exploitation of a large recoil enabled the separation to be effected. The helium-jet method was used for a rapid collection. The already known characteristics of α-emitting nuclei $82 < Z < 91$ are presented in tables which are completed with the results obtained for $65 < Z < 84$ nuclei (assigning of mass, α decay energy, measured value of the half-lives, α branching ratios expressed as a percentage). (FR)

28309 (JINR-P4-7690) PHENOMENOLOGICAL DESCRIPTION OF ROTATIONAL BANDS IN ODD-MASS NUCLEI BY MEANS OF THE PROJECTION TECHNIQUE. May, F. R.; Muenchow, L.; Frauendorf, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

By means of the angular momentum projection technique a phenomenological formula was constructed for the energy levels of rotational bands in odd-mass nuclei. The expression contains 3 parameters. The formula was tested for a great deal of the rotational bands of odd nuclei in the rare earth region as well as for the quasi-rotational bands of some odd nuclei of the 2pif-shell. It turned out that the formula reproduced the spectra better than the usually used expansion into powers of the angular momentum. (auth)

28310 (USNDC-9, pp 25-27; 28) LEVELS IN ^{184}W BASED ON (n,γ) AND β-DECAY EXPERIMENTS. Smither, R. K.; Bushnell, D. (Argonne National Lab., IL). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28311 (USNDC-9, pp 39-45) DIRECT CAPTURE STUDIES IN ^{152}Sm(n,γ)^{153}Sm. Cole, G. W.; Chrien, R. E. (Brookhaven National Lab., Upton, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28312 (USNDC-9, pp 48-51) SPINS OF ^{159}Tb RESONANCES AND THE ABSENCE OF EVIDENCE FOR NONSTATISTICAL EFFECTS. Ribon, P.; Cole, G. W.; Chrien, R. E. (Brookhaven National Lab., Upton, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28313 (USNDC-9, pp 66-67) STUDY OF THE ^{186}W(n,γ)^{187}W REACTION AT 24 keV AND THE BREAKDOWN OF THE NILSSON MODEL. Casten, R. F.; Breitig, D.; Wasson, O. A.; Rimawi, K.; Chrien, R. E. (Brookhaven National Lab., Upton, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28314 ELECTROMAGNETIC TRANSITION PROBABILITIES IN ODD-MASS ERBIUM ISOTOPES. Andrejtscheff, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Manfrass, P.; Prade, H.; Schilling, K. D.; Winter, G.; Fuia, H.; Ion-Mihai, R.; Khalikulov, A. B.; Morozov, V. A.; Marupov, N. Z.; Muminov, T. M. Nucl. Phys., A220: No. 3, 438-460(1974).

Nanosecond lifetimes of ^{163,165}Er excited states were measured by means of delayed $\gamma-\gamma$ coincidences in the (α,2n) reaction on enriched Dy targets and delayed γ-ce coincidences in the ^{163,165}Tm decay. The following half-lives unknown so far were obtained: $T_{\frac{1}{2}}$ (84.3 keV) = 0.92 ± 0.08 ns, $T_{\frac{1}{2}}$ (104.3 keV) = 0.52 ± 0.05 ns and $T_{\frac{1}{2}}$ (443.8 keV) = 0.58 ± 0.10 μs for ^{163}Er levels as well as $T_{\frac{1}{2}}$ (296.1 keV) ≦ 0.24 ns, $T_{\frac{1}{2}}$ (297.3 keV) = 0.70 ± 0.06 ns, $T_{\frac{1}{2}}$ (356.5 keV) = 0.35 ± 0.06 ns, $T_{\frac{1}{2}}$ (507.3 keV) = 0.70 ± 0.12 ns, $T_{\frac{1}{2}}$ (551.0 keV) = 0.25 ± 0.03 μs, $T_{\frac{1}{2}}$ (589.7 keV) ≦ 0.6 ns and $T_{\frac{1}{2}}$ (745.7 keV) =

1.00 ± 0.15 ns for ^{165}Er levels. From the investigation of γ-ray spectra populating the $11/2^-$[505] isomer, the rotational levels at 1024.0 keV ($J^\pi = 11/2^-$) and 1259.8 keV ($J^\pi = 13/2^-$) in ^{165}Er could be confirmed as well as the level at 1078.1 keV with $J^\pi = 17/2^-$ in ^{165}Er could be established. In order to obtain the wave functions of K-mixed nuclear levels, Coriolis coupling calculations taking into account the ΔN = 2 mixing in ^{165}Er are performed for ^{161,163,165}Er including in the fit all the experimentally known band-head and rotational energies of positive-parity and negative-parity states, respectively. Partial γ-ray half-lives of E1, M1 and E2 transitions in ^{161,163,165,167,169}Er are deduced from the present results and earlier data. Electromagnetic transition probabilities are calculated within a nonadiabatic approach and compared with the experimental values. The influence of pairing correlations and configuration admixtures on the transition probabilities is demonstrated using hindrance factors and numerical values of transition matrix elements. (auth)

28315 INTRINSIC AND ROTATIONAL EXCITATIONS IN ^{175}Lu. Foin, C.; Andre, S.; Hjorth, S. A. (Inst. of Nuclear Sciences, Grenoble, France). Nucl. Phys., A219: No. 2, 347-364(1974).

The γ-ray cascades following the ^{176}Yb(p,2n)^{175}Lu reaction are studied with Ge(Li) detectors and interpreted within the level scheme of ^{175}Lu. According to this interpretation the $1/2^+$[411], $1/2^-$[541], $5/2^+$[402], $7/2^+$[404] and $5/2^-$[514] rotational bands are observed up to the $15/2^+$, $21/2^-$, $13/2^+$, $13/2^+$ and $13/2^-$ members, respectively. Furthermore, the energy of the $1/2^-$, $1/2^+$[411] band head is determined to be 626.6 keV. The data for the rotational bands are discussed within the particle-rotor model and compared with the available information on the corresponding bands in the adjacent Lu isotopes. (auth)

28316 DYNAMIC COLLECTIVE MODEL INTERPRETATION OF THE PHOTONEUTRON CROSS SECTION OF ^{181}Ta. Hicks, R. S.; Spicer, B. M. (Univ. of Melbourne). Aust. J. Phys.; 26: No. 5, 585-595(Oct 1973).

The cross section for photoneutron production in ^{181}Ta was measured from threshold to 28.8 MeV using bremsstrahlung and direct neutron detection. Integrated between these limits, the absolute value of the cross section was determined to be 2.47 ± 0.35 MeV/b. An examination of the cross section variation with excitation energy reveals the existence of the giant quadrupole resonance lying on the high excitation edge of the dipole peak. This provides additional evidence for the validity of the dynamic collective model. The present data do not support the existence of extensive fine structure below 17 MeV, as proposed previously. (auth)

28317 LEVELS OF ^{106}Pd FORMED BY DECAY OF ^{106g}Rh ($T_{1/2}$ = 30S). Marsol, C.; Ardisson, G. (Institut d'Etudes Nucleaires, Algiers). Rev. Roum. Phys.; 18: No. 9, 1101-1118 (1973). (In French).

The decay of ^{106}Rh was reexamined using coaxial junctions of Ge(Li) of different volumes. The energies and intensities of 167 gamma transitions were measured; 78 of these were reported for the first time. The coincidence measurements were carried out using a mixed aggregate of Ge(Li)-NaI(Tl). A level scheme for ^{106}Pd is proposed with 36 excited states. Six new states were proposed at 2755.6, 2788.9, 2997.7, 3150.8, 3252.5, and 3274.8 keV. (tr-auth)

28318 STATISTICAL EMISSION IN TWO TERBIUM ISOTOPES FROM THE REACTIONS ^{156}Gd(p,n)^{156}Tb AND ^{157}Gd(p,n)^{157}Tb. Trutia, E.; Dumitrescu, R. (Institut de Physique Atomique, Bucharest). Rev. Roum. Phys.; 18: No. 9, 1125-1129(1973). (In French).

Statistical parameters a and T for two terbium isotopes were determined with the aid of the statistical model of the compound nucleus. The values a = (22.7 ± 4.7) MeV^{-1}, T = (0.479 ± 0.021) MeV for ^{156}Tb and a = (24.6 ± 0.4) MeV^{-1}, T = (0.505 ± 0.005) MeV for ^{157}Tb were obtained.

28319 EXPERIMENTAL DEMONSTRATION OF BACKBENDING BEHAVIOR FROM A BAND CROSSING IN ^{154}Gd. Khoo, T.L.; Bernthal, F.M.; Boyno, J.S.; Warner, R.A. (Cyclotron Laboratory, Departments of Physics and Chemistry, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. Lett. 31: No. 18, 1146-1149 (29 Oct 1973).

The members of the ground and β bands on ^{154}Gd have been identified to spin 18. Plots of $2I/\hbar^2$ versus ω^2 yield backbending curves for both the β and yrast states. It is shown that the backbending in the yrast sequence results from a band crossing, and it is speculated that the twin backbending may arise from the intersection of the ground and β bands by a third "intersecting band". (auth)

28320 HEXADECAPOLE MOMENTS OBTAINED BY SEMICLASSICAL AND QUANTUM MECHANICAL ANALYSES OF COULOMB EXCITATION. Wollersheim, H. J. (Univ., Frankfurt am Main); Wilcke, W.; Elze, T. W.; Pelte, D. Phys. Lett.; 48B: No. 4, 323-325(18 Feb 1974).

Electric quadrupole and hexadecapole matrix elements of rare-earth nuclei were determined from Coulomb excitation of the 2^+ and 4^+ rotational states in the ground-state band. The E4-matrix elements obtained by second-order perturbation expansion of the quantum mechanical theory and by a coupled channel code agree within 20%. (auth)

28321 OPTICAL MODEL ANALYSIS OF FAST NEUTRON TOTAL CROSS SECTION OF ^{165}Ho. Enayetullah, M.; Rahaman, M. (Atomic Energy Centre, Dacca, India). Nucl. Sci. Appl., Ser. B; 6: 7-8(Oct 1973).

The total neutron cross sections of ^{165}Ho in the energy range 0.2 to 19 MeV were analyzed using the optical model. A satisfactory fit was obtained for energy range 2 to 19 MeV. (auth)

28322 L- AND M-SUBSHELL CONVERSION RELATIVE INTENSITIES FOR 100 keV TRANSITION IN ^{183}W. Migahed, M.; Mostafa, M. A. (Atomic Energy Establishment, Cairo). Fizika (Zagreb); 5: No. 4, 195-202(Dec 1973).

A careful measurement of L- and M-electron conversion relative intensities in the 100 keV deexcitation of ^{183}W was performed by means of a reconstructed iron-free double focussing beta-ray spectrometer. The results of individual L- and L/M-conversion ratios as well as earlier reported experimental values for some other pure E2 transition for deformed nuclei in the rare earth region are compared with theoretical values by Hager and Seltzer and Pauli. This is done in order to reinvestigate the possibility of earlier reported discrepancies with theory for some of the above conversion ratios. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 28001, 28185, 28215, 28229, 28238, 28239, 28246, 28250, 28251, 28253-28255, 28258, 28261, 28267, 28268, 28276, 28280, 28298, 28302, 28307, 28308, and 28329.

28323 (FRNC-TH-457) STUDY OF A LEVEL SCHEME FOR ^{219}Rn. Ngo Tich Phuoc (Paris-11 Univ., 91 - Orsay (France)). 1972. 83p. (In French). Dep. NTIS (U. S. Sales Only) $7.25. Thesis.

The level scheme of ^{219}Rn was studied using interval conversion spectrometry, α-γ and γ-γ coincidence methods, and α-γ angular correlation methods. It is demonstrated that, in spite of the results obtained, the establishment of a level scheme poses many difficult problems. No information is available on the ground-state spins of either ^{219}Rn, its parent, ^{223}Rn, or its daughter, ^{215}Po; and there is little hope that an experiment could be performed with ^{219}Rn which would provide this fundamental information for the construction of a level scheme. Up to an excitation energy of 450 keV, all the levels have spins which differ by no more than 1 unit. There is no indication of any rotational band, and no model is available for postulating configurations. A rotational band with particle-vibration coupling with a parity opposite to that of the ground state might be sought in the energy range above 450 keV, e.g., the 446.7 (-), 491 (-), 541.7 (-), and 594.7(-) levels. Unfortunately, the current state of experimental data does not allow either the presence or the absence of such a rotational band to be confirmed. α emission probabilities are of little help. It might be considered that the α transition to the 158.7 keV level occurs preferentially; nevertheless, this concept assumes a continuity in the model between the initial state of ^{223}Ra and the final state of ^{219}Rn, and it is this continuity which is missing. (FR)

28324 (USNDC-9, pp 63-65) STUDY OF LOW SPIN STATES IN ^{202}Hg. Casten, R. F.; Breitig, D.; Kane, W. R.; Cole, G. (Brookhaven National Lab., Upton, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28-29, 1973.

28325 MAGNETIC MOMENT MEASUREMENTS ON Hg NUCLEI. Doubt, H. A.; Fechner, J. B.; Hagemeyer, K.; Kumbartzki, G. J.; Speidel, K. H. (Univ., Bonn). Nucl. Phys., A221: No. 1, 13-25(1974).

Perturbed particle-γ angular correlations were measured for Coulomb-excited ^{188,189,190,192,204}Hg recoiling into helium and vacuum at v/c = 0.010. Relative g-factors of the first 2^+ states of the even nuclei were obtained from the perturbation parameters and shown to be in disagreement with theoretical predictions and

IMPAC measurements. Absolute g-factors were extracted by calibrating the ionic hyperfine field with the 158 keV $5/2^-$ state in ^{199}Hg. This field is discussed in the light of the general systematics for atoms in the range $60 \leq Z \leq 80$. A lower limit was placed on the g-factor of the 208 keV state in ^{199}Hg. In a separate measurement using a radioactive source the lifetime of this state and the mixing ratio of the subsequent ground state transition were determined. (auth)

28326 ^{208}Pb(α,α'n) REACTION. Pong, W. S.; Austern, N. (Univ. of Pittsburgh). Nucl. Phys.; A221: No. 2, 221-237(1974).

DWBA calculations for the reaction ^{208}Pb(α,α'n) are performed, under the assumption that the incident α particle picks up a neutron from the target nucleus, forming an unstable intermediate ^{5}He system in the sharp $p_{\frac{3}{2}}$ resonant state. Encouraging agreement with experiments at 42 MeV and 65 MeV is found. Large cross sections are obtained, in contrast to results for the alternative knockout mechanism. The intermediate p-state causes a distinctive angular correlation pattern, initially found for plane waves, which tends to survive in DWBA. (6 figures, 1 table) (auth)

28327 TWO-STEP MECHANISM IN THE REACTION ^{208}Pb(p,t). de Takacsy, N.B. (Physics Department, McGill University, Montreal, Canada). Phys. Rev. Lett. 31: No. 16, 1007-1009 (15 Oct 1973).

It is shown that the differential cross section for the reaction ^{208}Pb(p,t) leading to the 3^+ (1.34-MeV) state of ^{206}Pb can be understood in terms of a two-step (p,d) -(d,t) mechanism. (auth)

28328 TRANSITION CHARGE DENSITY OF THE 3_1^- STATE IN ^{208}Pb. Nagao, M. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 5: 121-123(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The transition charge density of the 3^- state in lead-208 was investigated by inelastic electron scattering in the momentum transfer range from 0.56 to 2 fm^{-1}. Form factors show that the transition charge density should have another peak inside the surface peak. It is concluded that this method gives a better fit than the one-peak transition charge density. A value of B(E3) = $0.69^{+0.8}_{-0.3}$ e^2b^3 was obtained. (JFP)

28329 EXCITATION OF GIANT RESONANCES IN ^{208}Pb BY INELASTIC ELECTRON SCATTERING. Buskirk, F. R.; Graef, H. D.; Pitthan, R.; Theissen, H.; Titze, O.; Walcher, T. (Technische Hochschule, Darmstadt, Ger.). Kakuriken Kenkyu Hokoku; 5: 199-204(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

In order to search for E2 resonances, measurements were made on lead-208 with the electron scattering facility at energies of 50 and 65 MeV. The spectra and cross sections are plotted. (JFP)

28330 COUPLING BETWEEN IAS AND GIANT DIPOLE RESONANCE. Fujita, J. I. (Tokyo Univ. of Education). Kakuriken Kenkyu Hokoku; 5: 367-372(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

A review is given of the theory for the spin-flip E1 transition ($1h_{\frac{9}{2}} \rightarrow 2g_{\frac{9}{2}}$) in ^{209}Bi(e, e'p)^{208}Pb which is controversial, since for ^{208}Pb(p,γ)^{209}Bi no corresponding peak was found. (JFP)

28331 LEVEL STRUCTURE OF ^{205}Tl OBSERVED IN (p,p') AND (p,α) REACTIONS. Glashausser, C. (Rutgers—The State Univ., New Brunswick, NJ); Hendrie, D. L.; McClatchie, E. A. Nucl. Phys.; A222: No. 1, 65-78(1974).

A number of new levels in ^{205}Tl were observed in the ^{208}Pb(p,α) ^{205}Tl and ^{205}Tl(p,p')^{205}Tl reactions. The spectra observed in these reactions are very different from each other, and from spectra previously observed in the ^{206}Pb(t,α)^{205}Tl and ^{205}Tl(γ,γ')^{205}Tl reactions. Values of G_l (reduced transition probability in single-particle units) were deduced from the (p,p') data; they are in fair agreement with the predictions of the intermediate-coupling model. (auth)

28332 INELASTIC INTERACTIONS OF HIGH ENERGY NUCLEONS WITH HEAVY NUCLEI. Barashenkov, V. S.; Gerezhi, F. G.; Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; A222: No. 1, 204-220 (1974).

The intranuclear cascade model including the effect of changes in the properties of the target nucleus due to development of the shower of cascade particles is applied to calculations of the interactions of protons with fissioning nuclei in the energy region T ≈ 0.1 to 30 GeV. The fission cross sections, yields of different isotopes after the evaporation stage, and the characteristics of accompanying particles are calculated. The properties of the excited evaporating and fissioning nuclei are discussed. The calculated results are compared with experiment. (15 figures, 2 tables) (auth)

28333 QUANTAL TREATMENT OF OCTUPOLE COULOMB-NUCLEAR INTERFERENCE. Barnett, A. R.; Feng, D. H.; Goldfarb, L. J. B. (Univ. of Manchester, Eng.). Phys. Lett.; 48B: No. 4, 290-292(18 Feb 1974).

A quantal DWBA calculation of Coulomb-nuclear interference, for excitations of arbitrary multipolarity, was developed. Data for ^{208}Pb(α,α')^{208}Pb(3^-) at 21 and 22 MeV are presented and analyzed. The theory fits these and other data well. (auth)

28334 EXACT FINITE-RANGE DWBA ANALYSES OF (^{12}C,^{11}B) AND (^{12}C,^{13}C) REACTION FROM ^{208}Pb. Low, K. S.; Tamura, T. (Univ. of Texas, Austin). Phys. Lett.; 48B: No. 4, 285-289(18 Feb 1974).

A fast way to carry out the exact-finite range DWBA calculation is discussed, and is applied to the analyses of (^{12}C,^{11}B) and (^{12}C,^{13}C) reactions from ^{208}Pb. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 28253, 28267, 28276, 28323, 28332, and 28755.

28335 (FRNC-TH-431) STUDY OF SEMI-FAVORED α GROUPS IN AN ODD—ODD NUCLEUS AND INVESTIGATION OF NEGATIVE-PARITY ROTATIONAL BANDS IN AN EVEN—EVEN NUCLEUS. Establishment of the Existence of Double K Ionization in Internal Conversion. Chevallier, P. (Paris-5 Univ., 75 (France)). 1973. 184p. (In French). Dep. NTIS (U.S. Sales Only) $12.25.

Thesis.

The ^{220}Er levels obtained in the α decay of ^{224}Ac were studied using $\alpha-\gamma$ coincidence methods. A consistent scheme was established for these levels, and the multipolarities of important transitions above 80 keV were established. The existence was established of a weak β branching in the decay of ^{220}Fr. The spins and parities of the ground-state levels of ^{220}Fr and ^{224}Ac were established. The favored-α group concept and the empirical rules suggested for determining the energies and intensities in the case of heavy nuclei, considerably more deformed than Ac and Fr, can also be used in the region of transition nuclei. Electron capture-populated levels of ^{220}Th were studied using ^{220}Pa and $\gamma\gamma$ coincidences (Ge(Li) detectors) and conversion electron spectroscopy, either directly or in γe^- coincidence (cooled Si(Li) detectors). The positive-parity levels were interpreted in terms of the Faessler and Greiner rotation—vibration model. A two-phonon quadrupole vibration (β and γ) was identified (1009 keV). The search for negative-parity levels was particularly fruitful for the $K^\pi = 1^-$ band. The examination of the de-excitation of the 952, 971, 1012, 1079 and 1127 keV levels, which occur mainly in the region of the octupole and quadrupole bands, led to the advancing of a hypothesis on strong quadrupole—octupole coupled levels (configurations with an octupole phonon and a quadrupole phonon). The search for new 0^+ levels in the excited states of ^{220}Th did not yield much useful information. X_K X_K coincidence experiments demonstrated the presence of hypersatellites around the K_α and K_β lines of the pattern for the de-excitation of the isomeric level of ^{114}In. It was subsequently deduced that internal K conversion can lead to a double K ionization with a probability of occurrence of 1.1×10^{-4}. Double internal conversion, direct interaction, and shake-off are envisaged as mechanisms which could give rise to the double ionizations, shake-off being the most probable. (FR)

28336 (GA-A-12826) GANDY3: A COMPUTER PROGRAM FOR THE EVALUATION OF EFFECTIVE CROSS SECTIONS IN THE UNRESOLVED RESONANCE REGION. Mathews, D. R.; Koch, P. K. (General Atomic Co., San Diego, Calif. (USA)). 28 Jan 1974. Contract AT(04-3)-167. 105p. Dep. NTIS $5.45.

A computer program, GANDY3, was written to evaluate temperature-dependent effective neutron capture, fission, and scattering cross sections in the unresolved resonance region. Utilizing the isolated resonance approximation, the code considers s-, p-, and d-wave neutron orbital angular momenta and includes the effect of interference scattering. Fission cross sections were computed for chi-squared fission width statistical distributions with one, two, three, or four degrees of freedom. The program was written in the FORTRAN-IV language, and runs on a UNIVAC-1108 com-

puter. The GANDY3 program is a revised version of an earlier program called GANDY. (3 figures, 7 tables) (auth)

28337 (USNDC-9) REPORTS TO THE U.S. NUCLEAR DATA COMMITTEE MEETING AT ARGONNE NATIONAL LABORATORY, NOVEMBER 28–29, 1973. Bowman, C. D. (comp.). (National Bureau of Standards, Washington, D.C. (USA)). 1973. 242p. (EANDC(US)–186(U); INDC(USA)–62(U)). Dep. NTiS $7.60.

The reports in this document were submitted by laboratories having a substantial effort in measuring neutron and nuclear cross sections. They should be regarded as informal statements of recent developments and preliminary data. The following subjects are included: microscopic neutron cross sections relevent to the nuclear energy program, including shielding (and pertinent inverse reactions); charged-particle cross sections (where relevant to the above or to developing and testing nuclear models); gamma-ray production, radioactive decay, and theoretical developments in nuclear structure; and proton and alpha cross sections at energies up to 1 GeV. (RWR)

For title listings of selected papers see: 28192, 28193, 28228, 28241, 28242, 28263, 28280–28282, 28310–28313, 28324, and 28338–28343.

28338 (USNDC-9, pp 13-14) $^{233}U/^{235}U$ FISSION CROSS SECTION RATIO. Meadows, J. W. (Argonne National Lab., IL). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28339 (USNDC-9, pp 27; 29-30) SPONTANEOUS FISSION ISOMERISM. Wolf, K. L.; Unik, J. P.; Meadows, J. W. (Argonne National Lab., IL). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28340 (USNDC-9, pp 36-37) RADIOCHEMICAL INVESTIGATION OF FISSION FRAGMENT MASS DISTRIBUTIONS. Flynn, K. F.; Gindler, J. E.; Glendenin, L. E.; Sjoblom, R. K.; Gorski, A. J.; Unik, J. P. (Argonne National Lab., IL). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28341 (USNDC-9, p 38) HYPERFINE INTERACTION AND NUCLEAR MOMENTS IN EVEN URANIUM ISOTOPES FROM MOESSBAUER SPECTROSCOPY. Meeker, R. D.; Kalvius, G. M.; Dunlap, B. D.; Ruby, S. L.; Cohen, D. (Argonne National Lab., IL). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28342 (USNDC-9, pp 56-58) $^{238}U(n,\gamma)^{239}U$. Rimawi, K.; Wasson, O. A.; Chrien, R. E. (Brookhaven National Lab., Upton, NY). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laborabory, November 28–29, 1973.

28343 (USNDC-9, pp 82-83; 89-90) PULSED SPHERE MEASUREMENTS ON ^{235}U AND ^{239}Pu. Anderson, J. D.; Davis, J. C.; Grimes, S. M.; Haight, R. C.; Komoto, T. T.; Logan, C. M.; McClure, J. W.; Pohl, B. A.; Wong, C. (Univ. of California, Livermore). 1973.

In reports to the U. S. Nuclear Data Committee meeting at Argonne National Laboratory, November 28–29, 1973.

28344 SEARCH FOR COULOMB FISSION INDUCED BY ^{84}Kr IONS ON ^{238}U. Ngo, C.; Peter, J.; Tamain, B. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A221: No. 1, 37–44(1974).

A search was made for Coulomb fission induced by ^{84}Kr ions on a ^{238}U target at energies ranging from the interaction barrier down to 37 MeV below (408 to 458 MeV lab). No event attributed to Coulomb fission was detected; it was deduced that the cross section for this reaction is lower than 0.3 mb/sr near the interaction barrier. This value was compared to theoretical predictions. However, fission events originating from transfer reactions at the interaction barrier were detected. (auth)

28345 FRAGMENT ANGULAR DISTRIBUTIONS IN ELECTRON-INDUCED FISSION OF ^{232}Th. Rasch, P. (Univ., Giessen, Ger.); Fiedler, G.; Konecny, E. Nucl. Phys., A219: No. 2, 397–406(1974).

Fission fragment angular distributions were observed in electron-induced fission of ^{232}Th for electron energies 8.7 MeV $\leq E_e \leq$ 30 MeV. For low energies (though above the fission threshold) the angular distributions contain both a dipole and a quadrupole component. The (90°/0°) anisotropy decreases rapidly for higher electron energies but reveals smaller peaks after the onset of second-, third- and fourth-chance fission suggesting that the effective fission barriers for ^{231}Th and ^{229}Th in second- and fourth-chance fission, respectively, are both characterized by $K = \frac{1}{2}$. (auth)

28346 FRAGMENT MASS AND KINETIC ENERGY DISTRIBUTION IN ISOMERIC FISSION OF ^{240}Pu. Weber, J. (Univ., Munich); Specht, H. J.; Konecny, E.; Heunemann, D. Nucl. Phys.; A221: No. 2, 414–420(1974).

Fragment mass and kinetic energy distributions were measured for isomeric fission of ^{240}Pu. The mass distribution is asymmetric with the average heavy fragment mass nearly equal to that found for ground-state spontaneous fission of ^{240}Pu, but slightly lower than for $n_{th} + ^{239}Pu$ fission. The average total fragment kinetic energy appears to be higher in isomeric fission ($179.5^{+1.5}_{-1.4}$ MeV) than in spontaneous fission from the ground state (176.8 ± 1.8 MeV). (3 figures, 1 table) (auth)

28347 ALPHA DECAY OF ^{241}Am AND ^{242}Am. Dumitrescu, O.; Popescu, D. G. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 9, 1065–1081(1973).

The influence of the collective modes associated with nuclear pair and quadrupole correlations on the alpha decay hindrance factors is analyzed. It is shown that for some α-transitions to two Np isotopes the modes mentioned above are dominant and for the others (except the pure favored or some unfavored ones) their influence is not negligibly small. (auth)

28348 ALPHA DECAY OF ^{239}Pu. Dumitrescu, O. (Inst. of Atomic Physics, Bucharest); Petrascu, M.; Popescu, D. G.; Sandulescu, A. Rev. Roum. Phys.; 18: No. 10, 1231–1238(1973).

The influence of the complex structure of the low-lying ^{235}U-states on the corresponding alpha transitions is analyzed. The hindrance factors (HF) for seven rotational bands are computed. It is shown that the inclusion of the unfavored plus unfavored β-vibrational alpha transitions in addition to the favored plus favored β-vibrational alpha transitions improves considerably the agreement of the theory with the experiment. (auth)

28349 EXPANSION OF THE PERIODIC TABLE OF THE ELEMENTS. I. Kamke, D. (Univ., Bochum, Ger.). Phys. Bl.; 29: No. 10, 445–454(Oct 1973). (In German).

As introduction, the periodic table of elements and the build-up of the individual electron shells are given, with a brief look at the natural radioactivity leading to the search for transuranium elements. Following the description of a double separation process of short-lived isotopes, various heavy ion reactions are dealt with which are suitable for the prodution of transuranium elements. In conclusion, the question of whether it will be possible to make and prove the existence of elements beyond the actinides is discussed. (GE)

28350 EXPANSION OF THE PERIODIC TABLE OF THE ELEMENTS. II. Kamke, D. (Univ., Bochum, Ger.). Phys. Bl.; 29: No. 11, 493–497(Oct 1973). (In German).

The further accelerator developments are presented and the thus involved difficulties discussed. The report concludes with a brief glance at the future possibilities. (GE)

28351 MULTILEVEL CALCULATION OF ^{235}U NEUTRON FISSION CROSS-SECTION USING THE RANK ANNIHILATION METHOD. Mihailescu, I. M.; Petrascu, M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 10, 1219–1229(1973).

Using the rank annihilation method, recurrence formulas for calculating the level matrix elements are given. A multilevel expression of the neutron fission cross section is obtained. The iteration procedure depends on the number of the open fission channels. The ^{235}U fission cross section for neutron energies less than 2 eV is computed in two cases: one and two open fission channels. The results are compared with those obtained using Reich-Moore expressions. (auth)

28352 POLAR LIGHT PARTICLE EMISSION IN SPONTANEOUS FISSION OF ^{252}Cf. Adamov, V. M.; Drapchinskii, L. V.; Kovalenko, S. S.; Petrzhak, K. A.; Pleskachevskii, L. A.; Tyutyugin, I. I. (Radium Inst., Moscow). Phys. Lett.; 48B: No. 4, 311–314 (18 Feb 1974).

The energy-angular distributions of the light particles emitted in spontaneous fission of ^{252}Cf were measured. The yields of protons, tritons and α-particles at small angles with respect to the fission axis, $Y(0°)/Y(90°)$, are found to be (121 ± 14), (2.0 ± 0.3) and (4.44 ± 0.08)% correspondingly. The conclusion is made that polar α-particle emission holds for both light and heavy fragments. (auth)

28353 INELASTIC SCATTERING OF ^{84}Kr FROM ^{232}Th. Colombani, P.; Jacmart, J. C.; Poffe, N.; Ricu, M.; Stephan, C.; Singh,

P. P.; Weidinger, A. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett.; 48B: No. 4, 315-318(18 Feb 1974).

Inelastic scattering of ^{84}Kr on ^{232}Th was measured at E = 371 and 450 MeV and at different angles using the particle-gamma coincidence technique. It is found that for distances of closest approach smaller than about 20 fm the scattering of Kr on Th is mostly inelastic. At forward angles, the data are in agreement with predicted values from a Coulomb excitation program, but some differences are observed at backward angles. (auth)

28354 L X-RAY SPECTRA AND E2 INTERNAL CONVERSION COEFFICIENTS IN RADON AND RADIUM. de Pinho, A. G.; Weksler, M. (Pontificia Universidade Catolica, Rio de Janeiro). Z. Naturforsch.; 28a: No. 10, 1635-1641(Oct 1973).

The x-ray spectra resulting from the internal conversion of electric quadrupole transitions following the alpha decay of ^{230}Th and ^{226}Ra were analyzed with a Si(Li) spectrometer. From the knowledge of the Coster-Kronig and fluorescence yields, the internal conversion coefficients of the E2 transitions from the first excited states in ^{226}Ra and ^{222}Rn could be deduced. Results are in good agreement with theoretical values. (GE)

28355 MASS AND CHARGE DISTRIBUTIONS OF FISSION FRAGMENTS IN REACTIONS WITH ACCELERATED IONS Xe AND Kr. Oganesyan, Yu. Ts.; Penionzhkevich, Yu. E.; Nguen Tak An; Adamek, A.; Ngo Kuok Byu; Nguen Mong Shin. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 2, 245-251(Feb 1974). (In Russian).

Mass and charge distributions of the fission products from nuclei Ta and U exposed to the ions of Kr and Xe are measured. It is shown that dispersions of these distributions, as well as peculiarities of formation of the fragments, differ only slightly from those expected assuming the fission of a compound nucleus or a system produced at interaction of two composite nuclei. The obtained data are discussed in view of possible fission reactions induced by ions with A > 100 to synthesize new neutron-excess isotopes with Z > 75, in particular, the isotopes in the theoretically supposed stability region of superheavy nuclei (Z = 110 to 114 and N = 184). (auth)

28356 EXPERIMENTS OF FUSION SUPERHEAVY ELEMENTS IN REACTIONS WITH ACCELERATED Zn IONS. Pleve, A. A.; Demin, A. G.; Kush, V.; Miller, M. B.; Danilov, N. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 2, 252-258(Feb 1974). (In Russian).

The experiments on the synthesis of superheavy elements in the reactions induced by the accelerated zinc ions are described. The experimental technique was intended to registrate the spontaneous fission at operation with the external cyclotron beam. The experimental limits for the production cross sections and lifetimes of superheavy nuclei are given. (auth)

Nuclear Theory

Refer also to abstracts 27849, 27866, 28111, 28197, 28235, and 28271.

28357 (CEA-CONF-2492) HIGH-MOMENTUM ANALYSIS OF THE STRUCTURE OF NUCLEI. Gillet, V. (CEA Centre de La Hague, 50-Cherbourg (France). Section de Traitement des Combustibles au Plutonium). 1973. 50p. (CONF-730642-16). Dep. NTIS (U. S. Sales Only) $4.50.

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

After a discussion of the momentum content of nuclear wave functions, a review is given of theoretical and experimental results of high energy inelastic coherent scattering of electrons and hadrons with respect to the information they may bring on the distribution of high momenta in nuclei, on nuclear structure, on intrinsic deformed states and on nuclear clustering. (auth)

28358 (LA-5503) THEORY OF PION SCATTERING BY NUCLEI II. Bethe, H. A.; Johnson, M. B. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 5p. Dep. NTIS $4.00.

The Chew-Low theory is used to calculate the scattering of a pion by a nucleon inside nuclear matter. Together with the standard relation between refractive index and forward scattering, this yields the wave number of a pion inside nuclear matter. Singularities appearing in earlier theories are avoided. (auth)

28359 DROPLET MODEL ENERGY OF AXIALLY ASYMMETRIC NUCLEI. Leander, G. (Univ. of Lund, Sweden). Nucl. Phys., A219: No. 2, 245-252(1974).

The shape dependent factors of the droplet model energy are evaluated for the special case of an ellipsoid and expressed in terms of four incomplete elliptic integrals. Generalization to other axially asymmetric shapes is considered. (auth)

28360 BINDING ENERGY FOR INHOMOGENEOUS NUCLEAR MATTER. Ludwig, S. (Technische Hochschule, Darmstadt, Ger.). Nucl. Phys., A219: No. 2, 295-316(1974).

For a spatial finite nuclear density distribution a binding energy formula is developed. A modified Thomas-Fermi method which deduces the mixed density by taking into account an anisotropic local momentum space occupation is used. This method presents the binding energy as a functional of the proton and neutron density distributions. It was possible within this framework to derive in a consistent way the energy correction terms due to density inhomogeneities. The structure of these energy correction terms is shown and an estimate is given for the adjustable parameters of this model to fit the experimental nuclear masses. (auth)

28361 TWO EXACTLY SOLUBLE MODELS AS A TEST OF THE HERMITIAN OPERATOR METHOD. Bouten, M. (SCK-CEN, Mol, Belg.); Van Leuven, P.; Mihailovic, M. V.; Rosina, M. Nucl. Phys., A221: No. 1, 173-182(1974).

Two exactly soluble models, Lipkin's model and a pairing force model, are studied to test a previously introduced particle-hole method (the hermitian operator method) for the description of collective states. The results support the relevance of the particle-hole space for the calculation of certain excited states, as well as the adequacy of the approximations due to the hermitian operator method. The sensitivity of the results to the approximate input two-body density matrix is studied. (auth)

28362 PHASE TRANSITION AND DECOUPLING MECHANISMS IN NUCLEAR ROTATIONAL STATES. Krumlinde, J. (Lund Inst. of Tech., Sweden); Szymanski, Z. Nucl. Phys., A221: No. 1, 93-118(1974).

A simple, solvable model for nuclear rotation at high angular momenta is developed. It is argued that the model allows the system to choose between decoupling and a more sudden phase transition as a mechanism to produce back-bending. The conclusion seems to be mostly in favor for decoupling for our most common rare earth species but with a possibility for a pairing phase transition for some outsiders. (auth)

28363 OFF-ENERGY-SHELL BEHAVIOR IN P WAVES. Srivastava, M. K. (Univ. of Roorkee, India). Nucl. Phys., A221: No. 1, 183-190(1974).

The off-shell behavior of P-waves was studied by constructing phase shift equivalent second rank separable potentials in all the P-states. It is found that substantial changes in the off-shell reaction matrix elements can be produced over quite a wide range of momenta. The usefulness of incorporating these variations in the study of the spin-orbit splitting in nuclei and the P-wave contributions in nuclear matter and N-N bremsstrahlung calculations is pointed out. (auth)

28364 SIGNIFICANCE OF DETAILED BALANCE TESTS OF TIME REVERSAL INVARIANCE IN THE FLUCTUATION REGION. Klein, G.; Paetz, H. (Univ., Cologne). Nucl. Phys., A219: No. 2, 422-428(1974).

For detailed balance tests of time reversal invariance in the region of strongly overlapping resonances the underlying theory which was employed throughout is shown to exhibit a serious lack of empirical support. Certain conclusions that were drawn from that theory are critically examined and quantitative criteria as to the significance of such tests are derived. (auth)

28365 INTRANUCLEAR CASCADE. Decay of Excited Nuclei. III. pp 59-116 of Yadernye Reaktsii pri Vysokikh Ehnergiyakh. Denisov, F. B.; Makhedov, V. N. (eds.). Moscow; Atomizdat (1972). (In Russian).

The intranuclear cascade model is used for analysis of complex nuclear reactions. The high energy incident particle is examined as a classical particle moving along a fixed orbit and the nucleus as a system of classical particles with a specified volume, energy, and momentum distribution. The potential field interacting with the cascade particles is compared with the nucleus. With movement within the nucleus the incident particle can collide with one of the nuclear particles and the latter is assumed free during this collision. The collision products can interact with other nuclear particles. The cascade is completed when all particles participating in the collision escape from the nucleus or are absorbed by it. Fast particles escaping from the nucleus and excited post-cascade nucleus are the products of the cascade process. The Monte Carlo method is used for the calculation of the cascade process. Simulation of the intranuclear cascade by the Monte Carlo method is examined. The results of calculations by previous authors are discussed. The decay process of the residual nucleus with average excitation energy of 50 to 100 MeV is very

complex. Model representations, particularly the statistical model and the evaporation model, were used for a description of the decay. The results of some calculations of intranuclear nucleon cascades (total cross section of inelastic interaction, yields, angular distributions, and energy spectra of the secondary particles) are examined. The scheme of the cascade process is examined with consideration of the association of nucleons in the nucleus. (tr-auth)

28366 NUCLEAR EXCITATION ENERGY IN MUON CAPTURE. Christillin, P. (Istituto di Scienze dell'Informazione-Università di Pisa, Pisa, Italy); Dellafiore, A.; Rosa-Clot, M. Phys. Rev. Lett. 31: No. 16, 1012-1015 (15 Oct 1973).

Sum-rule techniques are used to evaluate total μ-capture rates. They turn out to be strongly dependent on the mean nuclear excitation energy, whose behavior along the nuclear table is discussed. (auth)

28367 HIGHLY EXCITED NUCLEAR MATTER. Chapline, G.F.; Johnson, M.H.; Teller, E.; Weiss, M.S. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Rev. D 8: No. 12, 4302-4308 (15 Dec 1973).

It is suggested that very hot and dense nuclear matter may be formed in a transient state in "head-on" collisions of very energetic heavy ions with medium and heavy nuclei. A study of the particles emitted in these collisions should give clues as to the nature of dense hot nuclear matter. Some simple models regarding the effects of meson and N* production on the properties of dense hot nuclear matter are discussed. (auth)

28368 GAMMA-QUANTUM EMISSION BY NUCLEI EXCITED BY HIGH-ENERGY HADRONS. Manenkov, S. I. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 18: No. 8, 316-318 (20 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 8, 535-538(20 Oct 1973).

It is shown with the aid of Glauber's theorem that the angular distribution of the gamma radiation is determined mainly by $[J/2]+1$ parameters. The remaining parameters due to the particle spins are small quantities. (auth)

28369 INELASTIC PROCESSES IN PARTICLE TRANSFER REACTIONS. Vertse, T. ATOMKI (At. Kut. Intez.) Kozlem.; 15: No. 2, 139-154(1973). (In Hungarian).

The basic processes in particle transfer reactions are reviewed. The origins of (d,p) reactions are discussed. (2 figures) (JSR)

28370 REDUCTION OF STATISTICAL UNCERTAINTIES ASSIGNED TO MEASUREMENTS OF NUCLEAR PROCESSES. Rogers, V. C.; Sandquist, G. M. (Brigham Young Univ., Provo, Utah). Int. J. Appl. Radiat. Isotop.; 25: No. 3, 131-135(Mar 1974).

The proper application of the binomial distribution is shown to give a reduced value for the variance assigned to measurements of appropriate nuclear processes even when the initial number of particles under consideration varies. The method is illustrated by several examples incorporating physical and Monte Carlo experiments. (auth)

28371 COLLINEAR THREE-CENTER SHELL MODEL. Badralexe, E. (Inst. of Atomic Physics, Bucharest); Rizea, M.; Sandulescu, A. Rev. Roum. Phys.; 18: No. 9, 1083-1100(1973).

For the microscopic description of the phenomenon of light-particle accompanied fission (LPAF) a simple three-center shell model is developed, in terms of the potential of three harmonic oscillators with collinear centers. The eigenfunctions and eigenvalues of the corresponding Hamiltonian are obtained as the solutions of a set of 7 simultaneous equations. The asymptotic behavior of the wave functions is then studied and explicitly displayed. In view of the applications to the shell-model, also analytic expressions are obtained for the matrix elements of the terms $l\sigma$ and l^2 and also for the polynomial in ρ and z. (auth)

28372 PION SPECTRUM IN NUCLEAR MATTER AND π CONDENSATION. Migdal, A. B.; Markin, O. A.; Mishustin, I. N. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 2, 443-463(Feb 1974). (In Russian).

The π^+, π^- and π^0-meson spectra in nuclear matter with Z = 0 (neutron star) and Z = N (nucleus) are determined by taking into account nucleon correlations. It is shown that for nucleon matter with a density $n > n_c^+ \approx 0{,}4n_0$ a branch with negative energies $\omega^+ < -\epsilon_p^n$ appears in the π^+-meson spectrum. This leads to instability of protons in the medium ($p \to n + \pi^+$), i.e. the matter of neutron stars should consist of neutrons and a small admixture of π^+-mesons whose charge is compensated by electrons. At a neutron density $n > n_c^+ \approx 0{,}8n_0$ an instability with respect to $\pi^+\pi^-$-meson pair production arises and at about the same density the π^0-meson field becomes unstable. This results in phase transitions of the second kind with the formation of π condensates. The π^--meson condensate suggested previously does not arise. In nuclear matter with Z = N and at a density $n = n_c \approx 0{,}6n_0$ less than the nuclear density n_0 an instability with respect to simultaneous π^+, π^-, π^0 production arises and this leads to a phase transition of the second kind with the formation of an electroneutral π^+, π^-, π^0-meson condensate. This should affect the characteristics of nuclei. (auth)

28373 NUCLEAR STRUCTURE STUDIES USING ELECTRON SCATTERING AND PHOTOREACTION. Proceedings of the International Conference on Nuclear Structure Studies Using Electron Scattering and Photoreaction, Sendai, Japan, September 12–15, 1972. Shoda, K.; Ui, H. (eds.). (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 5: 556(1972). (CONF-720907-).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972).

Forty-six papers were presented at this conference. Separate abstracts were prepared for 36 of these; the remaining ten have already been abstracted for NSA. For abstracts of these papers, see CONF-720907- in a Cumulative Report Number Index. (RWR)

For abstracts of individual papers see: 27764, 27820, 28001, 28178–28181, 28204–28212, 28232–28234, 28249–28252, 28268, 28297–28300, 28328–28330, and 28374–28378.

28374 DOORWAY STATES AND INELASTIC ELECTRON SCATTERING. Fallieros, S. (Brown Univ., Providence). Kakuriken Kenkyu Hokoku; 5: 185-198(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

A discussion of some simple properties of transition densities as they appear in inelastic electron scattering experiments is presented. The concept of doorway states is introduced, and the nature of their participation in the excitation process is described; sum rules are derived that impose limitations on the properties of these states, and it is shown how approximations on the number of participating doorways can lead to simple predictions which can be compared with experimental results. (JFP)

28375 ISOBARIC ANALOG RESONANCE STUDIED BY THE (e,e'p) REACTIONS ON MEDIUM AND HEAVY NUCLEI. Shoda, K.; Sugawara, M.; Saito, T.; Miyase, H.; Suzuki, A.; Oikawa, S.; Uegaki, J. (Tohoku Univ., Tomizawa, Japan). Kakuriken Kenkyu Hokoku; 5: 321-337(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The nature of the isobaric analog resonance (IAR) strongly excited by the E1 interaction is discussed. The E1 radiative width is treated. Radiative widths for nuclei with A = 89 to 210 obtained from (e,e'p) reactions are plotted. The values of $2(T+1)\Gamma_\gamma^{IAS}/\Gamma_{p_0}$ are found to be anomalously large for the spin-flip type IAR or for the nuclei in the deformed region. The energy distributions of protons emitted from the low-lying IAR strongly excited by E1 interactions are considered. It was concluded that the configurations of the E1 IAS in even–even nuclei must be superpositions of several E1 configurations which are raised from various proton shell states in the core. This is quite similar to the configuration of the giant dipole resonance. The excitation of such IAS including proton hole states in proton scattering experiments can not be expected. Finally, the energy of the $T_>$ giant resonance is examined. It was found that, in general, the isospin splitting energy could be well explained theoretically. (12 figures, 1 table) (RWR)

28376 EFFECTS OF GIANT DIPOLE RESONANCE ON (e,e'p) REACTIONS THROUGH ISOBARIC ANALOG STATES. Ejiri, H. (Osaka Univ., Toyonaka, Japan). Kakuriken Kenkyu Hokoku; 5: 339-342(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The problem of whether spin-flip E1 transition probabilities are as large as nonspin-flip E1 transition probabilities is considered. Authors studying the (γ,p) reaction have published that spin-flip amplitudes in medium-heavy nuclei were as big as nonspin-flip ones, while the (p,γ) people have said that they must be small. It should be noted that the (γ,p) reaction through isobaric analog resonances corresponding to the (p,γ) reaction is only the (γ,p_0) reaction, but the E1 matrix elements from the (γ,p) reactions are based on the total proton yields—most of them are p' feeding excited states. The amplitudes involved are examined closely, and it is hoped that proper understanding of the points raised in the analysis of the (γ,p') reaction will improve agreement with the (p,γ) results. (3 figures) (RWR)

28377 CALCULATION OF ELECTRON SCATTERING MATRIX ELEMENTS. Onley, D. S. (Ohio Univ., Athens). Kakuriken Kenkyu Hokoku; 5: 385-389(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

A method is described for overcoming some of the mathematical difficulties associated with the distorted wave method as applied to electron scattering. (JFP)

28378 PHOTO-ABSORPTION AND NUCLEAR CORRELATIONS. Kohmura, T. (Tokyo Univ. of Education); Tanabe, K.; Futami, Y.; Fujii, A. Kakuriken Kenkyu Hokoku; 5: 391-398(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

The possibility of experimental observation of short-range correlations in nuclei is reconsidered. It is found that it is possible to determine short-range correlations from the differential cross sections for forward proton emission, and the cross section divided by that for the deuteron helps to compare the short-range correlations in both nuclei. (JFP)

28379 ALPHA PARTICLE SPECTROSCOPIC AMPLITUDES IN THE j−j COUPLED SHELL MODEL. Kurath, D. (Argonne National Lab., IL); Towner, I. S. Nucl. Phys.; A222: No. 1, 1-12 (1974).

Formulas for calculating spectroscopic amplitudes for α-transfer reactions are developed in the framework of the j−j coupled harmonic oscillator shell model. It is shown that the amplitudes can be written as a sum of coupled two-neutron and two-proton spectroscopic amplitudes, this result illustrating that many properties of α-transfer reactions can be understood in terms of previous experience with two-nucleon-transfer reactions. (2 figures, 2 tables) (auth)

28380 CORE POLARIZATION EFFECTS AND THE RANDOM PHASE APPROXIMATION SOLUTION. Warke, C. S. (Tata Inst. of Fundamental Research, Bombay). Pramana; 2: No. 1, 28-34 (Jan 1974).

Simplified formulae for the effective electromagnetic transition matrix elements and the core polarization contribution to the effective two-nucleon interaction are derived. From these general expressions, the polarization effects in any other physical quantity of interest can easily be written down. It is also proved that the usual RPA eigenvalue problem corresponding to a $2n \times 2n$ matrix $\begin{pmatrix} A & B \\ -B & -A \end{pmatrix}$ is equivalent to the diagonalization of a $n \times n$ matrix $(A + B)(A - B)$. (auth)

28381 MEDIUM ENERGY (p,n) REACTIONS ON LIGHT "CLOSED SHELL" NUCLEI. Moffa, P. J.; Walker, G. E. (Indiana Univ., Bloomington). Nucl. Phys.; A222: No. 1, 140-160 (1974).

Differential cross section and polarization predictions are presented for medium-energy ($E_p \geq 100$ MeV) (p,n) reactions on light closed-shell nuclei. The influence on the predicted cross section of various spin- or momentum-dependent effective interactions is studied. The advantage of comparing the (p,n) experimental results with recent or anticipated (e,e') experiments leading to the excitation of T = 1, high-spin, nonnormal-parity "particle−hole" states is stressed. It is argued that by doing (p,p') and (p,n) at medium energies with machines possessing high beam current, variable energy, and good resolution, one should be able to make significant progress in understanding both the reaction mechanism and the relevant nuclear structure. Specific examples of exotic states that are predicted to be observable at large momentum transfer are a 6^-, T = 1 $(1f_{\frac{7}{2}})(1d_{\frac{5}{2}})^{-1}$ state in ^{28}Si(p,n)^{28}P* and a 4^-, T = 1 $(1d_{\frac{5}{2}})(1p_{\frac{3}{2}})^{-1}$ state in ^{16}O(p,n)^{16}F*. Form factor minima associated with wave function radial nodes may also be observable. (8 figures, 3 tables) (auth)

28382 BINDING ENERGY OF ASYMMETRIC NUCLEAR MATTER. Sjoberg, O. (NORDITA, Copenhagen). Nucl. Phys.; A222: No. 1, 161-167(1974).

The energy per particle of bulk nuclear matter was calculated in the nuclear matter pair approximation over a wide range of density and symmetry parameter, α. (6 tables) (auth)

28383 PION CONDENSATION IN NEUTRON STAR MATTER: EQUILIBRIUM CONDITIONS AND MODEL CALCULATIONS. Baym, G.; Flowers, E. (Univ. of Illinois, Urbana). Nucl. Phys.; A222: No. 1, 29-64(1974).

The equilibrium thermodynamic conditions obeyed by a pion-condensed state of dense neutron or neutron star matter are derived. Then simple model calculations of negative pion condensation in neutron star matter are carried out. In the simplest of these models, consisting of a p-wave pion−nucleon interaction alone, a local minimum in the free energy corresponding to a pion-condensed phase is found; but at larger density it is found that matter is unstable to the formation of an ever increasing pion condensate. This model is made more realistic by including other forces: s-wave pion−nucleon interactions, pi−pi interactions, and phenomenological form factors in these interactions. These modifications have little influence on the stability of the system. Finally, effects of repulsive nuclear forces on pion condensation are considered in a simple model, in which only a simplified repulsive zero-range nucleon−nucleon interaction proportional to $\sigma \cdot \sigma' \tau \cdot \tau'$ is retained. The density for the pion threshold is very sensitive to the strength of this force. This model of the nuclear force greatly reduces the instability of the system, although it is too crude to restore stability completely. It also indicates the important role which nuclear forces play in a correct description of the pion-condensed phase. (7 figures, 4 tables) (auth)

28384 PROCEEDINGS OF THE EUROPHYSICS STUDY CONFERENCE ON INTERMEDIATE PROCESSES IN NUCLEAR REACTIONS, PLITVICE LAKES, YUGOSLAVIA, AUGUST 31−SEPTEMBER 5, 1972. Cindro, N.; Kulisic, P.; Mayer-Kuckuk, T. (eds.). Lecture Notes in Physics, No. 22. New York; Springer-Verlag (1973). 342p. (CONF-720863-). $10.70.

Ten papers (plus Summary and conclusions) are presented in this volume. Separate abstracts were prepared for nine of these; the remaining one has already appeared as NSA 27: 18786. (RWR)

For abstracts of individual papers see: 28216, 28217, 28254, 28271, and 28386−28390.

28385 INELASTIC PROTON SCATTERING WITH SKYRME FORCES. Davies, K. T. R.; Satchler, G. R. (Oak Ridge National Lab., TN). Nucl. Phys.; A222: No. 1, 13-28(1974).

Finite-range Gaussian potentials are derived whose Fourier transforms agree to order k^2 with Skyrme-type interactions used recently in nuclear structure studies. Particular attention is given to the three-body contact term and the two-body density-dependent potential which is equivalent to it for certain purposes. The excitation of the lowest 3^- and 5^- states of ^{40}Ca by inelastic proton scattering is calculated. Surprisingly good agreement is obtained with the measured cross sections. There is strong cancellation between the contributions from the two-body and three-body interactions. (3 figures, 3 tables) (auth)

28386 PRESENT STATUS OF INTERMEDIATE REACTION THEORIES. Mahaux, C. (Univ., Liege). pp 1-42 of Proceedings of the Europhysics Study Conference on Intermediate Processes in Nuclear Reactions. Cindro, N. (ed.). New York; Springer-Verlag (1973).

From proceedings of the europhysics study conference on intermediate processes in nuclear reactions; Plitviec Lakes, Yugoslavia (31 Aug 1972). See CONF-720863-.

The review of intermediate reaction theories covers the theoretical framework, doorway states, the isolated doorway state, intermediate structure, and partial widths correlation due to direct reactions. (JFP)

28387 NUCLEAR EQUILIBRATION PROCESSES AT MODERATE EXCITATIONS. Blann, M. (Univ. of Rochester, NY). pp 43-83 of Proceedings of the Europhysics Study Conference on Intermediate Processes in Nuclear Reactions. Cindro, N. (ed.). New York; Springer-Verlag (1973).

From proceedings of the europhysics study conference on intermediate processes in nuclear reactions; Plitviec Lakes, Yugoslavia (31 Aug 1972). See CONF-720863-.

Several related models are examined which were applied to the equilibration question trying to give a simple qualitative description of the underlying physical assumptions of each model, discussing contrapunctually their similarities and their differences. Comparisons of predictions of the several models with one another are presented. Also comparison is made with experimental results. (JFP)

28388 PRE-EQUILIBRIUM EMISSION IN NEUTRON AND PROTON INDUCED REACTIONS. Gadioli, E. (Univ., Milan); Milazzo-Colli, L. pp 84-116 of Proceedings of the Europhysics Study Conference on Intermediate Processes in Nuclear Reactions. Cindro, N. (ed.). New York; Springer-Verlag (1973).

From proceedings of the europhysics study conference on intermediate processes in nuclear reactions; Plitviec Lakes, Yugoslavia (31 Aug 1972). See CONF-720863-.

It is shown that the pre-equilibrium model can also satisfactorily predict the absolute cross sections of many reactions induced by neutrons and protons in target nuclei spanning the entire periodic table. This mechanism takes into consideration the emission of particles during the nuclear cascade initiated in a nucleus by a projectile. (JFP)

28389 ENERGY-AVERAGED S-MATRIX AND DOORWAY RESONANCES. von Brentano, P. (Univ., Cologne). pp 267-277 of Proceedings of the Europhysics Study Conference on Intermediate Processes in Nuclear Reactions. Cindro, N. (ed.). New York; Springer-Verlag (1973).

From proceedings of the europhysics study conference on intermediate processes in nuclear reactions; Plitviec Lakes, Yugoslavia (31 Aug 1972). See CONF-720863-.

The doorway resonance concept is discussed from a pure S-matrix point of view. The S-matrix point of view shows why the various theories end up giving the same S-matrix for an isolated doorway resonance. This formulation allows also in a simple way the discussion of the case of many overlapping doorway resonances. The energy-averaged S-matrix is discussed in detail. (JFP)

28390 SIMPLE STRUCTURES IN THE EXIT CHANNEL. Papineau, L. (CEN de Saclay, Gif-sur-Yvette, France). pp 295-316 of Proceedings of the Europhysics Study Conference on Intermediate Processes in Nuclear Reactions. Cindro, N. (ed.). New York; Springer-Verlag (1973).

From proceedings of the europhysics study conference on intermediate processes in nuclear reactions; Plitviec Lakes, Yugoslavia (31 Aug 1972). See CONF-720863-.

The role of simple configurations in nuclear reactions and the important role they play in the occurrence of intermediate structures are discussed. Residual states and exit channels are treated. (JFP)

28391 FORTRAN PROGRAM TO CALCULATE FINITE-RANGE NO-RECOIL DWBA TRANSFER CROSS SECTIONS. Payne, G. L.; Von Behren, P. L. (Univ. of Iowa, Iowa City). Comput. Phys. Commun.; 7: No. 1, 13-37(Jan 1974).

The computer program FINITE RANGE DWBA PHASE 1 written in FORTRAN for the IBM 360/65 computer is described for the calculation of the angular distributions produced by direct nuclear transfer reactions. In this type of reactions one assumes that a nucleon or cluster of nucleons is transferred directly from a bound state in the projectile nucleus to a bound state in the target nucleus. The angular distributions are calculated by using DWBA with additional approximation of no-recoil. (JFP)

28392 FISSION WIDTH OF HEATED NUCLEI. Strutinskii, V. M. (Inst. of Nuclear Research, Moscow). Yadern. Fiz.; 19: No. 2, 259-262(Feb 1974). (In Russian).

On basis of the Kramers model an interpolated expression is obtained for the fission width of a heated nucleus that is valid for various limiting cases. Incorrectness of the conventional expression for Γ_f for excited nuclei is discussed. (auth)

28393 SELF-CONSISTENCE IN THE SHELL-CORRECTION METHOD. Tyapin, A. S. Yadern. Fiz.; 19: No. 2, 263-274(Feb 1974). (In Russian).

The proof of the shell-correction method is discussed. The Hartree-Fock approximation and the Brueckner K-matrix method are used to show that the shell correction can be approximately calculated as a difference between the correct and statistical estimations of the sum of one-body energies of the filled states in the nuclear-shell-model potentials chosen from the condition of the best description of the nucleon separation energies. (auth)

28394 MAGNETIC MOMENTS OF ODD-MASS DEFORMED NUCLEI IN THE NONADIABATIC MODEL. Bazhat, M. I.; Pyatov, N. I.; Chernei, M. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 2, 275-282(Feb 1974). (In Russian).

Magnetic dipole moments of odd-mass nuclei are considered in the framework of the nonadiabatic rotational model, including effects of the Coriolis interactions, spin and centrifugal polarizations. Equations are obtained for the effective gyromagnetic factors g_K^{eff} and g_I^{eff} of the adiabatic model and their behavior in rotational bands is investigated. Systematic calculations of the nuclear magnetic moments in the rare-earth and transuranium regions are carried out. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

28395 PLASMA PHYSICS INDEX. Volume 9, No. 2, 1974. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 146p.

Confinement and Heating

28396 (AD-768597-7-GA) OPTIMAL CONFINEMENT OF COLLISIONLESS PLASMAS BY LOCALIZED TIME-VARYING ELECTRIC FIELDS. Wang, P. K. C. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Jul 1973. 37p. (UCLA-Eng-7353; AFOSR-TR-73-1633). NTIS $3.00.

The problem of optimal confinement of collisionless plasmas by means of external amplitude-limited time-varying electric fields localized to an outer layer enclosing the confinement region (a specified closed bounded spatial domain) is considered. To confine the plasma, the external electric field (control) establishes a finite potential barrier for the escaping particles. The field direction for confinement depends on the sign of the electrical charge of the escaping particles inside the layer. A formal development of the plasma equations is presented. Then, the existence and uniqueness of solutions of these equations are established. This is followed by the formulation of the optimal confinement problem along with a discussion of the existence of an optimal electric field (control). By introducing additional assumptions to simplify the problem, suboptimal feedback controls are obtained. Finally, the effectiveness of the derived feedback controls is determined numerically using a computer-simulated plasma. (auth)

28397 (AD-769077-9-GA) THEORETICAL STUDY OF NON-LTE PROCESSES IN LASER-HEATED PLASMAS. Final Report, 15 June 1973–14 June 1973. Tamor, S. (Science Applications, Inc., La Jolla, Calif. (USA)). Oct 1973. Contract DNA001-72-C-0215. 46p. (SAI-73-545-LJ; DNA-3175-F). NTIS $3.00.

The development of a code for calculating the non-LTE kinetics of the excitation and ionization of a laser-heated plasma, and prediction of the emitted x-ray spectrum is described. This code is intended to be used for exploratory studies in which x-ray conversion efficiencies for various densities, compositions, temperature profiles, etc., are calculated. To carry out such computations rate coefficients for all possible transitions must be available. A simple method of calculating these rates is derived. Since numerous runs involving a wide range of parameter choices are envisaged it is desired that the basic time step in the integration be very large. The resulting problem of stiffness of the rate equations and methods of overcoming it are discussed. Preliminary results for a neon plasma are presented. (auth)

28398 (CONF-740402-2) TRANSPORT CALCULATIONS FOR D–T BURNING TOKAMAK REACTORS. Stacey, W. M. Jr. (Argonne National Lab., Ill. (USA)). 1973. 12p. Dep. NTIS $3.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

One-dimensional particle and energy balance equations are solved for a 50–50 D–T burning Tokamak operating in the reactor regime. Steady-state solutions which satisfy MHD equilibrium and stability criteria are obtained for banana, plateau, and classical transport coefficients by suitable enhancement of the coefficients. The effects of trapped particle instabilities and impurities are investigated. (auth)

28399 (COO-2277-3) HIGH-β CAPTURE AND MIRROR CONFINEMENT OF LASER-PRODUCED PLASMAS. Semi-annual Report, August 1, 1973–January 31, 1974. Haught, A. F.; Polk, D. H.; Woo, J. T.; Fader, W. J.; Tomlinson, R. G.; Jong, R. A.; Ard, W. B. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). 31 Jan 1974. Contract AT(11-1)-2277. 49p. (UARL-N-921514-20). Dep. NTIS $5.50.

Experimental studies aimed at improving the reproducibility of the dense, laser produced plasmas were performed. Efforts in this area were concerned with the positioning of the target particle more accurately in the laser focal region and with preventing the premature displacement of the particle from the focal region. To address this latter problem, the single beam laser system of the previous experiments was modified to permit the simultaneous irradiation of the lithium hydride pellet by two opposed laser beams. In addition, the diagnostic capabilities of the present experiment were augmented so that more detailed measurements of the plasma lifetime, density, and energy can be made. A 4 mm microwave interferometer was installed to follow the plasma decay from higher densities. The measured density decay histories were analyzed to give estimates of the plasma lifetime and energy. Independent measures of the time dependence of the plasma radius were obtained from both microwave interferometry and optical streak photography. To measure the energy distribution of the ions which escape through the mirror loss cones, an electrostatic ion energy analyzer was developed. The theoretical effort in support of the experimental program dealt with the solution of the rate equations and Fokker–Planck equations which describe the confined plasmas in the Laser Initiated Target Experiment (LITE). The rate equation analysis of the plasma heating and evolution to steady state with neutral injection using the LITE parameters indicates that a 0.5 Ampere current of 10-keV neutrals with intensity 5 mA/cm^2 at the target will balance the Coulomb decay and charge exchange losses with the neutral background and will sustain a plasma of density $\geq 10^{12}$ cm^{-3}. In addition, self-consistent Fokker–Planck calculations (now including the effects of charge exchange with the background neutrals) were performed to give the time evolution of the particle energies, density, and plasma potential. The design of the neutral beam line for the charge exchange heating and neutral injection experiments was completed. To accommodate the energetic neutral flux while maintaining the necessary high vacuum conditions, a self-consistent calculation, including recycling of the neutral flux from the walls, has shown the need for an enlarged experiment chamber to provide more effective pumping. The criteria on which the designs of the experiment chamber and the neutral beam line are based, are discussed. (auth)

28400 (COO-2288-3) ABSORPTION OF ELECTROMAGNETIC RAYS NEAR THE CRITICAL DENSITY. Quarterly Progress Report, June 1, 1973–September 1, 1973. Daiber, J. W.; Rehm, R. G.; Thompson, H. M. (Calspan Corp., Buffalo, N. Y. (USA)). 1973. Contract AT(11-1)-2288. 7p. Dep. NTIS $4.00.

An experimental study of the interaction of high-intensity ruby laser radiation with hydrogen gas in a free-jet is described. In these experiments both laser intensity and the plasma frequency can be varied. By monitoring several parameters, including incident and reflected power, x-ray emission and the kinematics of plasma growth, the existence of an anomalous threshold for coupling radiation into plasma energy should be determinable. A discussion of the experiment, including a design drawing of the experimental arrangement and the diagnostic instrumentation, is included. (auth)

28401 (EUR-CEA-FC-713) WEGA LOWER HYBRID HEATING EXPERIMENT. Pesic, S. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Nov 1973. 32p. Dep. NTIS (U. S. Sales Only) $4.75.

Some aspects of the WEGA lower hybrid heating experiment were investigated. The position of the lower hybrid resonance was determined for various radial density profiles and toroidal magnetic field strengths. The propagation of wave energy towards the resonance is discussed. The necessary retardation in the parallel refractive indices imposed by the accessibility criteria and the coupling impedance are computed. The wave coupling to the plasma was studied and appropriate launching-structures are suggested. Some uncertainties on wave coupling in fusion-scale devices are removed. (FR)

28402 (LRP-77-73) PLASMA BOX USING MAGNETIC MULTIPOLE CONFINEMENT. Hirt, P. J.; Tran, M. Q. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Dec 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

A plasma box using alternating magnetic multipole confinement is described. With disk shaped magnets a good confinement is achieved, the plasma lifetime being of the order of 200 μs. Consequently, a very low electron emission current (200 mA, heating power 250 VA) is required to maintain densities up to 2×10^9 cm^{-3} in argon, with an electron temperature of 2.5 eV and an ion temperature of 0.8 eV. The temperature ratio may be changed with a Maxwell demon between 2.0 and 5.3. (auth)

28403 EFFECT OF A LIMITER ON OHMIC DISCHARGES IN THE HELIOTRON D. Uo, K.; Morimoto, S.; Konoshima, S.; Koyama, M.; Iiyoshi, A. (Plasma Physics Laboratory, Faculty of Engineering, Kyoto University, Uji, Japan). Phys. Rev. Lett. 31: No. 16, 986-989 (15 Oct 1973).

Ohmic discharges with and without a limiter are being studied in the Heliotron D. Without the limiter, we observe longer containment time and lower impurity concentration than with the limiter, and a stable

current with the safety factor $q_{0s} \simeq 0.4$ is obtained. With the limiter, strong current fluctuations are observed near rational values of the rotational transform, i.e., $\iota/2\pi = (\iota_F + \iota_{0s})/2\pi \simeq 0.5$ and 1.0 (auth)

28404 HEATING OF A PLASMA WITH $T_i > T_e$ BY FAST θ COMPRESSION. Kishimoto, H.; Gotô, S.; Itô, H. (Plasma Physics Laboratory, Faculty of Engineering, Osaka University, Yamada-Kami, Suita, Osaka, Japan). Phys. Rev. Lett. 31: No. 18, 1120-1123 (29 Oct 1973).

Plasma heating by fast θ compression has been studied using an initial plasma with $T_i > T_e$ and $n \sim 10^{14}$ cm^{-3}, which is produced by collision of two plasma streams ejected from θ-pinch guns. Both ions and electrons are heated up to 3-4 keV with a maximum heating rate of 20 eV/nsec. After the magnetic field becomes maximum, two-temperature distributions are observed for the ions. (auth)

28405 EXPERIMENTAL INVESTIGATION OF PLASMA HEATING BY A HIGH-FREQUENCY ELECTRIC FIELD NEAR THE ELECTRON CYCLOTRON RESONANCE IN THE FM-1 SPHERATOR. Okabayashi, M.; Chen, K.; Porkolab, M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 31: No. 18, 1113-1116 (29 Oct 1973).

Plasma heating due to a high-frequency electric field near the electron cyclotron resonance is investigated in a toroidal plasma confinement device, the FM-1 spherator. It is observed that electrons and ions are heated "anomalously" when the incident high-frequency field exceeds a threshold value. Above the same threshold the parametric decay instability of upper and lower hybrid waves takes place. We investigate the effect of the decay instability and plasma heating on the confinement time. (auth)

28406 STOCHASTIC HEATING OF IONS IN A MODULATED ELECTRON BEAM-PLASMA SYSTEM. Miyoshi, S.; Ishii, S.; Ando, K.; Okamoto, K. (Inst. of Physical and Chemical Research, Tokyo). Phys. Lett.; 46A: No. 7, 491-492(11 Feb 1974).

A modulation of an electron beam density at frequencies lower than an ion cyclotron frequency enhanced the low-frequency instability of broad band and heated plasma ions in a beam-plasma system. The heating of ions is explained by the stochastic process of a weakly turbulent plasma. (auth)

Diagnostics

28407 (AD-768598-5-GA) COMPARISON OF ION-BEAM-PROBE AND LANGMUIR-PROBE DIAGNOSTIC TECHNIQUES. Glowienka, J. C. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA). Plasma Dynamics Lab.). Jul 1973. 97p. (RPDL-73-2; AFOSR-TR-73-1632). NTIS $3.75.

Thesis.

A comparison is made of two diagnostic techniques for magnetically confined plasmas—the Langmuir probe technique and the ion beam probe technique. The comparison is made for plasma charged particle number density and plasma electron temperature measurements on the Rensselaer hollow cathode discharge. The principles, theory, and system description required to understand and operate each probe are discussed. Experimental results taken with each device on the same plasma are given and compared. It is found that one or both techniques need to be extended for a more valid comparison. Work towards a more sensitive ion beam probe is mentioned with this comparison in mind. In addition, the application of the ion beam probe to a study of a plasma with a coherent instability and the feedback stabilization of the instability is discussed. (auth)

28408 TEMPERATURE MEASUREMENT IN AN ARGON JET. Slechta, J. (Czechoslovakia Academy of Sciences, Prague). Pr. Inst. Masz. Przeply.; No. 62-63, 165-169(1973).

A short review is given of spectroscopic temperature measurements in argon plasma jets. Two regions were observed in the jet, a bright core and a far less radiating outer zone. In the spectrum of the core, continuous radiation and neutral argon lines are present. The broadening of the lines decreases rapidly in the passage to the outer zone and their intensity quenches rapidly. The molecular spectrum of the outer zone indicates the presence of air. (MOW)

28409 PHASE-SENSITIVE MICROWAVE REFLECTOMETER FOR PLASMA DIAGNOSTICS. I. The Reflectometer. Zakrzewski, Z. (Instytut Maszyn Przeplywowych, Danzig). Pr. Inst. Masz. Przeply.; No. 62-63, 229-238(1973).

A simple phase-sensitive microwave reflectometer is described which allows the complex reflection coefficient in a wave guide to be measured. The working principles, analysis of errors, and calibration experiments are described. (MOW)

28410 PHASE-SENSITIVE MICROWAVE REFLECTOMETER FOR PLASMA DIAGNOSTICS. II. Application to Electron-Density Measurements in Gas-Discharge Plasmas. Zakrzewski, Z.; Lubanski, M.; Kopiczynski, T. (Instytut Maszyn Przeplywowych, Danzig). Pr. Inst. Masz. Przeply.; No. 62-63, 239-245(1973).

A description of direct measurements of electron density in a positive column of glow discharge plasma in noble gases is presented. The measurements were performed in steady-state conditions, as well as in the presence of density oscillations. (MOW)

28411 MEASUREMENTS OF CHARGED-PARTICLE DENSITY AND ELECTRON TEMPERATURE IN AN INDUCTIVE, HYDRODYNAMIC SHOCK TUBE USING PLASMA FILTER. Rothhardt, L. (Zentralinstitut fuer Electronenphysik, Jena, Ger.). Pr. Inst. Masz. Przeply.; No. 62-63, 75-78(1973). (In German).

The plasma filter may be regarded as a double probe Johnson-Malter system. The system usually employed in measuring the density of charge carriers was used simultaneously for measuring the electron temperature. The results of these measurements, carried out in an inductive-hydrodynamic shock tube filled with different gases, are presented. Also, the application of the plasma filter to electron temperature measurements is discussed. (auth)

28412 CALCULATION OF THE DISTRIBUTION DENSITY OF PLASMA ELECTRONS FROM DATA ON THE SCATTERING SPECTRUM OF MONOCHROMATIC RADIATION. Shushurin, S. F.; Matyushkin, L. V.; Mitsuk, V. E. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 4, 489-491(1973). (In Russian).

A problem on the calculation of the density of the velocity distribution is presented and solved in the relativistic case on the basis of the Compton theory of light scattering. The method is a second independent spectroscopic method differing from the method based on the use of data on the absolute intensity of spectral lines of plasma radiation. (JSR)

28413 MEASUREMENT OF THE LOCAL VALUES OF THE ION TEMPERATURE IN A TOKAMAK USING CHARGE EXCHANGE OF PLASMA IONS WITH A JET OF HYDROGEN ATOMS. Afrosimov, V. V.; Petrov, M. P.; Sadovnikov, V. A. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 18: No. 8, 300-302(20 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 8, 510-514(20 Oct 1973).

A method is described for measuring local plasma-ion energy distribution, based on injection of a stream of hydrogen atoms into the plasma and using this stream as an artificial target for resonant charge exchange of the ions. The first results of the use of this method with the Tokamak-6 installation are presented. (auth)

28414 METHOD OF MEASURING LOCAL PLASMA PARAMETERS WITH THE AID OF A BEAM OF FAST ATOMS. Kudryavtsev, A. M.; Sorokin, A. F. (Inst. of Nuclear Physics, Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 8, 286-288 (20 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 8, 486-490(20 Oct 1973).

A method is described for measuring the ion distribution function in a small fraction of the plasma volume, and of measuring the spatial profile of the plasma density by means of the atoms produced by charge exchange of the plasma ions with the fast atoms of the diagnostic beam. Results of measurements in an open trap with crossed E and H fields are presented. (auth)

Kinetics (General)

28415 (AD-768596-9-GA) KINETIC THEORY OF UNSTABLE PLASMAS FOR THERMONUCLEAR POWER. Final Scientific Report. McCune, J. E. (Massachusetts Inst. of Tech., Cambridge (USA)). May 1973. 7p. (AFOSR-TR-73-1634). NTIS $3.00.

A brief review is given of progress made in a study of the interaction of an intense electron beam with a dense plasma. (auth)

28416 (FRNC-TH-429) THEORETICAL AND EXPERIMENTAL STUDY OF CRYOGENIC He PLASMAS. Vauge, C. (Paris-11 Univ., 91 - Orsay (France)). 1972. 186p. (In French). Dep. NTIS (U. S. Sales Only) $11.50.

Thesis.

A detailed bibliography of numerical data available on plasmas is presented. The effect of a drop in temperature on the behavior

of the afterglow, and in particular, the occurrence of large quantities of new ion species such as the triatomic ion, He_3^+ was studied. Calculations were effected on the structure, ground state vibration frequencies and dissociation energy using molecular physics methods. The interaction energy of this system was obtained by applying the same methods of calculation to the system formed between a He_2^+ ion and a helium atom. It was shown that some transport coefficients associated with this potential, such as the mobility, can be described by an effective spherical potential simply deduced from the interaction energy. The resulting mobility is in reasonably good agreement with the experimental measurements. A complex experimental device was developed enabling afterglows in very pure helium to be produced and investigated at temperatures of between 300°K and 4.2°K. The results obtained on both charge diffusion and the disappearance of charges by recombination enable a plasma model to be proposed in which neutral particles in a metastable state account for the electron production occurring in a cryogenic afterglow. (FR)

28417 THERMAL REGIME IN PLASMATRON OPERATION. Kryzhanovskii, O. M.; Chaika, B. I.; Roskoshnyi, V. G.; Savinov, A. I. Fiz. Khim. Obrab. Mater.; No. 6, 3-6(1973). (In Russian).

The thermal regime of plasmatron operation was studied on the UPU-3 apparatus. Temperatures in the plasma jet arc were measured with an automatic photoelectric spectropyrometer using the intensity of the continuous radiation spectrum of the plasma-forming gas. The dependence temperature of the plasma jet temperature on the arc current strength and the gas consumption was determined. (tr-auth)

Kinetics (Experimental)

28418 (AD-768792-4-GA) AIR PLASMA PROPERTIES AT HIGH TEMPERATURES. Final Report. Maecker, H. (Technische Univ. Muenchen (F. R. Germany)). Nov 1973. 47p. (ARL-73-150). NTIS $4.50.

In order to investigate the properties of air mixtures and related gases, cascade arc chamber of 5 mm dia are fed with the gas desired. Careful measurements of the field strength and the total radiation depending on current and gas composition were carried out. An apparatus for spectroscopic temperature measurements with evaluation by computer technique on-line was installed. Temperature measurements were performed. For the special case of hydrogen, viscosity measurements were done. In the spectrum of an oxygen arc burning in a quartz tube at low currents the affinity continuum due to attachment of free electrons to neutral oxygen atoms could be found and measured whereby the affinity energy could be determined. (auth)

28419 PRELIMINARY EXPERIMENTS ON COAXIAL PLASMA ACCELERATOR WITH INITIAL WORKING CONDITIONS DETERMINED BY PLASMA INFLOW. Rothhardt, L.; Jahn, G. (Zentralinstitut fuer Electronenphysik, Jena, Ger.). Pr. Inst. Masz. Przeply.; No. 62-63, 79-83(1973). (In German).

Information is given about preliminary experiments on the application of a coaxial plasma accelerator wherein the initial working conditions depend on the frontal flow of the incoming plasma. The plasma front was kept flat in the experiments. With the use of the equipment available it was possible to execute such time conditions wherein the focusing of the plasma may be expected. (auth)

Kinetics (Theoretical)

28420 (AD-763438) THEORY OF PLASMA TURBULENCE. Marcuvitz, N. (New York Univ., N. Y. (USA)). Jun 1973. Contract N00014-67-A-0467-0018. 45p. NTIS $3.00.

The nonlinear stochastic equations descriptive of a turbulent field belong to a class of perturbation problems that can be solved via the formal theory of scattering. With a proper choice of unperturbed operators, formally exact operator solutions can be derived and expanded into explicit, rapidly convergent, nonsecular representations of the fields and their transport properties. These results may be obtained via operator algebra or diagram methods, the former being preferred. The theory is illustrated for the case of a simple electron plasma wherein kinetic equations for particles and for waves are derived. The derivation appears to be analytically more transparent than that of Dupree's and has the virtue of exhibiting explicitly higher order terms, some of which are novel. (auth)

28421 GENERALIZED WIEDEMANN–FRANZ LAW. Lupu, G. (Inst. of Marine, Constanza, Romania). Czech. J. Phys.; 24: No. 1, 63-65(1974).

It was found that for a homogeneous, fully ionized high-frequency plasma, the ratio $\lambda/\sigma T_e^2$ (the Wiedemann–Franz law), in α^2 approximation, becomes: $\lambda/\sigma T_e^2 = C + W(T_e^{-1(\alpha)})$ $j \epsilon (1, 6)/3$. The expression W is evaluated. (auth)

28422 ELECTRONIC THERMAL CONDUCTIVITY OF A COMPLETELY IONIZED PLASMA AT SMALL VALUES OF THE COULOMBIAN LOGARITHM. Gauthier, J. C. (Paris Univ., Orsay, France). Compt. Rend., Ser. A, B; 277: No. 21, 631-633(26 Nov 1973). (In French).

The correction factor which extends the domain of validity of the expression for the electronic thermal conductivity of a plasma completely ionized at small values of the Coulombian logarithm was calculated. A satisfactory agreement exists with the available experimental results. (FR)

28423 INVERSION OF HYDROGEN LEVEL POPULATIONS IN STATIONARY PLASMAS. Skorupski, A. A.; Suckewer, S. (Inst. of Nuclear Research, Warsaw). Phys. Lett.; 46A: No. 7, 473-474(11 Feb 1974).

Large inversions in the dense two-temperature hydrogen plasma are obtained by solving balance equations with inelastic collisions between heavy particles taken into account. (auth)

Production

Refer also to abstracts 26790 and 28399.

28424 (AD-767923-6-GA) K-SHELL LINE RADIATION FROM LASER PRODUCED ALUMINUM PLASMAS. Whitney, K.; Davis, J.; Oran, E. (Naval Research Lab., Washington, D.C. (USA)). Jun 1973. 76p. (NRL-MR-2644). NTIS $3.75.

Two rate equation models are developed to describe the emission of K-line radiation from laser-produced aluminum plasmas. In the first model, the temperature of the electrons is a freely variable quantity; whereas, in the second model, it is computed from a kinetic energy equation in which phenomenological terms representing thermal conduction and laser energy absorption are introduced. The latter model predicts x-ray emission from a hot-spot of plasma in close agreement with observations from an experiment initiated by focusing 1.9 J of neodymium radiation in a $\frac{1}{4}$ nanosecond pulse onto an aluminum target. Computer solutions to the rate equation model are obtained for a number of different prescribed time variations of the electron temperature. These solutions are compared to a similar set of solutions to a coronal model. It is found that these two sets of solutions differ significantly whenever the electron temperature varies rapidly over subnanosecond periods and the aluminum plasma has not been overheated and driven to the state of total ionization. (auth)

28425 (CEA-CONF-2474) FILLING-UP OF CLOSED MAGNETIC CONFIGURATIONS USING A LASER CREATED PLASMA. Tonon, G. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de la Physique du Plasma et de la Fusion Controlee). 1973. 17p. (In French). (CONF-730574-13). Dep. NTIS (U. S. Sales Only) $3.00.

From congress on the centenary of the French Physics Society; Vittel, France (28 May 1973).

The interaction of a laser beam with a pellet of solid deuterium injected directly into the center of a magnetic configuration was studied. The characteristics of the laser pulse were chosen in such a way as to completely ionize the pellet. The expansion of the plasma in a closed magnetic configuration was studied. (FR)

28426 (LA-5481-MS) CALCULATION OF IONIZATION IN HYDRODYNAMICS CODES. I. Theory. Nachamkin, J. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 7p. Dep. NTIS $4.00.

A formalism is developed for calculating ionization in laser driven hydrodynamics codes. Starting from equations for collisional ionization and radiative recombination, approximations are made to allow their easier solution. Steady-state solutions are assumed to be of most importance to the extent that transient solutions to the rate equations are ignored. Free-bound radiation is also treated in a hydrogenic approximation. (auth)

28427 (SLA-74-5071) PRODUCTION AND FOCUSING OF INTENSE RELATIVISTIC ELECTRON BEAMS AND THEIR APPLICATION TO CONTROLLED FUSION. Toepfer, A. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 25p. (CONF-740316-4). Dep. NTIS $3.25.

From conference on electrostatic and electromagnetic confinement of plasmas and the phenomenology of relativistic electron beams; New York, New York, USA (4 Mar 1974).

The key problems that must be overcome for electron beam-driven fusion are discussed. The electron beam source, energy coupling between the source and target, target design, and extension of the concept to a power reactor are discussed. (MOW)

28428 PLASMA SOURCE OF CHARGED PARTICLES. Pleshivtsev, N. V.; Semashko, N. N.; Chukhin, I. A. US Patent 3,798,488. 19 Mar 1974. Filed date 28 Jul 1971. 12p.

A plasma source of charged particles is provided by an arrangement having two solenoids mounted on a single axis and connected in opposition in a gas-discharge chamber to set up a magnetic field increasing along the radius. The arrangement also includes two electrodes in the gas-discharge chamber one of which made in the shape of a disk having at least one emission slit placed approximately on the median surface of the magnetic field, and a system for charged particle extraction, acceleration, and focusing. (Official Gazette)

Stability

Refer also to abstract 28453.

28429 (EUR-CEA-FC-710) rf STABILIZATION OF THE DRIFT DISSIPATIVE INSTABILITIES. Watanabe, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Oct 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

The stabilization of drift dissipative instabilities in an inhomogeneous plasma using an rf electric field was investigated. The time dependent equations to which the plasma density fluctuations (or potential fluctuation) should be subjected were derived from the two fluid slab model and the values required for the frequency and amplitude of the applied electric field required for stabilization were determined. (FR)

28430 (FRNC-TH-427) LINEAR AND NONLINEAR THEORY OF THE INSTABILITIES OF PARTICLES TRAPPED AT LOW FREQUENCIES IN TOKAMAK. Jablon, C. (Paris-11 Univ., 91-Orsay (France)). 1972. 225p. (In French). Dep. NTIS (U. S. Sales Only) $13.25.

Thesis.

Collisional (trapped ions) and noncollisional instabilities occurring in Tokamak devices were studied. A simplified linear theory of these instabilities is presented and the regions in which they exist defined as a function of the normally considered parameters. The saturation of the collisional mode by the nonlinear de-trapping of the ions was then investigated. Formulas enabling the level of nonlinear saturation to be evaluated in certain experimental cases are indicated. A study was effected of the radial dependence of the modes and a nonlinear study effected on the noncollisional mode. The consequences of a small aspect ratio on the collisional mode were analyzed. The turbulent diffusion induced by the instabilities was examined and compared with that described by neoclassical theory. (FR)

28431 (LRP-73-73) TRANSFER FUNCTION OF A RETRO-ACTION-STABILIZED HELICOIDAL PINCH. Keller, R. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Nov 1973. 26p. (In French). Dep. NTIS (U. S. Sales Only) $4.50.

The feedback control system to be used to stabilize the kink mode of a screw pinch is discussed. Optical and magnetic detection systems are compared, taking into account the coupling between the probe and the feedback control windings. It was found that the impedance of the feedback amplifier may be positive or negative, depending on stability conditions. (auth)

28432 (LRP-76-73) USEFUL FORM OF THE VARIATIONAL PRINCIPLE OF IDEAL MHD FOR ONE-DIMENSIONAL NUMERICAL STABILITY CALCULATIONS. Appert, K.; Berger, D.; Gruber, R. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Dec 1973. 11p. Dep. NTIS (U. S. Sales Only) $4.00.

The variational problem of ideal one-dimensional MHD stability is examined by the method of Ritz-Galerkin. Finite elements are taken as the basic functions. In order to find the best approximating elements a radius dependent transformation was performed on the eigenvectors. The matrices of the transformed eigenvalue problem are given explicitly. (auth)

28433 (ORNL-TM-4512) HYDROMAGNETIC KINK MODE OF A TWO-REGION RUNAWAY ELECTRON BEAM. Spong, D.; Clarke, J. F. (Oak Ridge National Lab., Tenn. (USA)). Apr 1974. Contract W-7405-eng-26. 21p. Dep. NTIS $4.25.

An analysis is made of the stability against kink modes of a relativistic beam having two velocity regions. The analysis closely parallels that done by Lee for a beam having constant velocity over the cross section. The result is a sufficient condition for stability which indicates that a slight destabilization may occur when the velocity is higher on the outside whereas stabilization occurs when the inner velocity is highest. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 27295, 27370, and 27375.

28434 (CLM-R-127) DESIGN OF STAINLESS STEEL BLANKET CELLS FOR A FUSION REACTOR. Stanbridge, J. R.; Carruthers, H. M.; Keen, B. A.; Shotter, H. A. (UKAEA Research Group, Abingdon. Culham Lab.). Jan 1974. 29p. Dep. NTIS (U. S. Sales Only) $4.50. UK 50 pence.

The design limiting feature of AISI 316 stainless steel cells of a lithium-cooled fusion reactor blanket is the exhaustion of ductility by irradiation creep caused by stresses induced by the lithium coolant circulation pressure. Within the limitations of the available data, it is shown that the maximum permissible wall loading of cylindrical sectioned cells designed for a dwell time of 5 years is 2.2 MW/m^2. This is about a factor 3 higher than the wall loading of the same cell designed for full reactor lifetime dwell, and also a factor of 3 higher than the corresponding wall loading for a free standing hexagonal sectioned cell. Analysis of the neutron leakage through holes between adjacent close nesting cylindrical cells is shown to be ≈1% of the incident neutron flux. Design variations of the basic cylindrical and hexagonal cell shapes, and other blanket cell design problems, are discussed. (auth)

28435 (CONF-740402-3) CROSS-SECTION SENSITIVITY OF TRITIUM BREEDING IN FUSION REACTOR BLANKETS. Tobias, M.; Steiner, D. (Oak Ridge National Lab., Tenn. (USA)). 1973. 13p. Dep. NTIS $3.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

The objective of the present study is the identification of cross-section uncertainties which might produce uncertainties of the order of several percent in the tritium breeding ratio in fusion reactor blankets. The model chosen was the bench-mark configuration specified at the Neutronics Session of the International Working Sessions on Fusion Reactor Technology. Using ENDF/B version 3 cross sections and an $S_4 - P_3$ transport calculation, calculations of the effects of substantial cross section changes were performed both individually and in selected pairs which would leave the total cross section of an isotope unchanged. The cross sections most worth further study were the ^{7}Li(n,n'α)t, the ^{93}Nb (n,2n) and (n,n') reactions. (auth)

28436 (LRP-74-73) MAGNETIC FIELD MEASUREMENTS IN A CURVED THETA PINCH WITH LIMITERS. Hofmann, F.; Simik, A. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Nov 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

The Curved Theta Pinch Experiment, which uses an oscillating axial current to establish a toroidal equilibrium, was modified by introducing quartz limiters at the ends of the discharge tube. Recent measurements are described for the new version of the device. In contrast to previous experiments, it is observed that the oscillating axial current flows mainly through the dense plasma column. (auth)

28437 (UCID-16451) TELEMICROSCOPE SYSTEM FOR INSPECTING AND PHOTOGRAPHING LASER TARGET ALIGNMENT. Ready, R. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jan 1974. Contract W-7405-eng-48. 13p. Dep. NTIS $3.00.

A simple optical design composed of two identical units set at right angles to one another provides for the inspection of laser target alignment in x, y, and z coordinates. The system also makes photographic records of the target placement. (auth)

28438 (UCRL-51455) POSSIBILITY OF A HIGH-ENERGY-STORAGE VISIBLE LASER ON THE AURORAL LINE OF OXYGEN. Murray, J. R.; Rhodes, C. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Sep 1973. Contract W-7405-eng-48. 43p. Dep. NTIS $4.00.

The auroral line of oxygen at 5577 Å has properties which may make it useful for a high energy storage, short pulse, visible gas laser. Reactions and kinetics which would affect the operation of an auroral line laser are reviewed. A kinetic model of a possible laser using photolytic decomposition of N_2O by krypton excimer radiation is described. Other possible excitation mechanisms are discussed. (auth)

28439 (UCRL-51482) VOLTAGE HOLDING CONSIDERATIONS FOR DIRECT-COLLECTION UNITS. Miley, G. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Dec 1973. Contract W-7405-eng-48. 44p. Dep. NTIS $4.00.

Results have been obtained from initial experiments designed to study high-voltage breakdown under conditions of importance to the design of direct-collection units. A coaxial configuration was used to mock-up critical fields near grid wires. With appropriate heat conditioning, fields as high as 9.6×10^5 V/cm were maintained at the surface of a 7-mil-diam tungsten wire. This represents an enhanced field of $\sim 10^9$ V/cm at "whisker" sites. Breakdown criteria are proposed for three regimes; initial, field-emission, and ultimate, which differ by the amount of prior conditioning applied to the wire. Additional considerations of importance to direct collectors such as the effect of thermionic emission and ion bombardment are discussed. (auth)

28440 HELIUM COOLING OF FUSION REACTORS. Hopkins, G. R.; Melese-d'Hospital, G. (Gulf General Atomic Co., San Diego, CA). Nucl. Eng. Des.; 26: No. 1, 215-230(1974).

Basic equations relating temperatures, pressure drop, power generation and geometry are derived for cooling the vacuum wall and blanket regions of a fusion reactor with pressurized helium. Numerical results are presented for two cases which are applicable to use of a direct cycle pressurized helium gas turbine for power conversion in a fusion power reactor system. (auth)

28441 ELECTRON BEAM-PUMPED GAS LASER SYSTEM. Krawetz, B.; Long, J. B.; Mooney, L. J. (to United States Atomic Energy Commission). US Patent 3,789,321. 29 Jan 1974. Filed date 14 Sep 1972. 6p.

An electron beam-initiated-and-sustained gas laser system capable of producing uniform, high-energy, large-volume electrical discharges in a high-pressure gaseous lasing medium is described. A thin metallic window separates the low pressure electron gun cavity from the longitudinally parallel high pressure gas cavity, such that the injected primary electrons create low energy secondary electrons which are swept across the gas cavity by an applied electric field collisionally exciting the gaseous medium. The system is applicable in both the oscillator and amplifier configurations, and is capable, for example, of producing a 10 joule/liter of active volume short ($tp \approx 1$ ns) CO_2 laser pulse, while being operable in a manned area due to the housing being electrically neutral. (Official Gazette)

28442 HIGH-EMISSION COLD CATHODE. Mancebo, L. (to United States Atomic Energy Commission). US Patent 3,789,310. 29 Jan 1974. Filed date 14 Sep 1972. 4p.

A field-emission cathode having a multitude of field emission points for emitting a copious stream of electrons when subjected to a high field is described. The cathode is constructed by compressing a multitude of tungsten strips alternately arranged with molybdenum strips and copper ribbons or compressing alternately arranged copper plated tungsten and molybdenum strips, heating the arrangement to braze the tungsten and molybdenum strips together with the copper, machining and grinding the exposed strip edges of one side of the brazed arrangement to obtain a precisely planar surface, etching a portion of the molybdenum and copper to leave the edges of the tungsten strips protruding for electron emission, and subjecting the protruding edges of the tungsten strips to a high electric field to degas and roughen the surface to provide a large number of emitting points. The resulting structure is particularly useful as a cathode in a transversely excited gaseous laser where the cathode is mounted in a vacuum chamber for emitting electrons under the influence of a high electric field between the cathode and an extractor grid. The electrons pass through the extractor grid, a thin window in the wall of the laser chamber and into the laser chamber which is filled with a gaseous mixture of helium, nitrogen, and carbon dioxide. A second grid is mounted on the gaseous side of the window. The electrons pass into the laser chamber under the influence of a second electric field between the second grid and an anode in the laser chamber to raise selected gas atoms of the gaseous mixture to appropriately excited states so that a subsequent coherent light beam passing through the mixture transversely to the electron stream through windows in opposite ends of the laser chamber stimulates the excited atoms to amplify the beam. (Official Gazette)

28443 SOME REACTOR IMPLICATIONS OF LASER FUSION. Spalding, I. J. (Culham Lab., Abingdon, Eng.). Energ. Nucl. (Milan); 21: No. 3, 176-187(Mar 1974).

Some technological aspects of blanket design, operating frequency, and pellet production in a laser-compression reactor are discussed. Economic implications of the concept are then reviewed: assuming electrical pumping of the laser system, it is important to minimize the circulating power by using very efficient lasers ($\eta_l \sim 0.15$ to 0.30) and achieving a high burnup in the compressed core. The desirability of a high repetition rate ($f \sim 50$ Hz), to allow an adequate margin in the capital cost of laser components, is demonstrated, and an estimate of typical costs for a 530 MW(e) deuterium–tritium fueled system is presented. Economic operation of a pure DD system is shown to be much more difficult to achieve. Finally, the way in which these conclusions may be modified by alternative laser pumping techniques, and some physical factors which might affect published thermonuclear gain calculations, are summarized. (auth)

28444 SLAB LASER SYSTEM WITH MEANS TO OVERCOME THE POSITIVE LENS EFFECT CAUSED BY THE THERMAL GRADIENT IN THE LASER ROD. Segre, J. P. (to American Optical Corp.). US Patent 3,798,571. 19 Mar 1974. Filed date 9 Jun 1969. 8p.

In a glass laser system, the laser glass is in the shape of an elongated slab, which is excited by being irradiated through larger sidewalls. A calcite block plate in combination with quarter and half wave plates laterally shift the laser rays in the laser cavity to compensate for a positive lens effect caused by one dimensional thermal gradient in the laser glass. The calcite block and quarter and half wave plates also function to polarize the laser rays to have their E vectors parallel with the larger sidewalls of the slab. (Official Gazette)

28445 ATMOSPHERIC PRESSURE INDUCTION PLASMA LASER SOURCE. Willett, C. S. (to Secretary of the Army). US Patent 3,798,568. 19 Mar 1974. Filed date 31 Jul 1972. 6p.

An atmospheric pressure induction plasma laser source which enables high power, large diameter laser systems to be operated at atmospheric pressures in materials having high melting points and which can be selectively excited in charge transfer or Penning reactions is discussed. The disclosed apparatus provides a non-molecular laser that is operable at atmospheric pressure in a structure open to the atmosphere or in a circulatory system. It also will enable laser oscillation to be realized in elements and compounds that have heretofore been unable to lase due to their difficulty in vaporizing at reasonable temperatures. (Official Gazette)

28446 METAL VAPOR LASER DISCHARGE DEVICE. Hernquist, K. G. (to RCA Corp.). US Patent 3,798,486. 19 Mar 1974. Filed date 6 Nov 1972. 8p.

A low noise metal vapor laser discharge device of simple construction employing an anode electrode, a cold cathode electrode and condenser is described. The device features a relatively long intermediate portion, including a bore region and metal vapor store region, which communicates with the bore region at a plurality of spaced points along the length of the bore region, extending between the anode electrode and condenser. (Official Gazette)

28447 POLYMETHINE DYE LASERS. McColgin, W. C.; Webster, F. G. (to Eastman Kodak Co.). US Patent 3,798,566. 19 Mar 1974. Filed date 11 Nov 1971. 14p.

Merocyanine dyes which contain a pyran nucleus as part of the intercyclic chain are useful as laser dyes. These dyes are used in solution with a non-interfering solvent to form lasing media useful in dye lasers. Such lasers generally include a reservoir for containing the laser dye solution and a pumping energy source operably associated therewith for producing stimulated emission of the laser dye solution. (Official Gazette)

28448 ITALIAN PROGRAM ON THE CONTROLLED THERMONUCLEAR FUSION. Toschi, R. (CNEN–EURATOM, Frascati, Italy). Energ. Nucl. (Milan); 21: No. 2, 99-108(Feb 1974). (In Italian).

The Italian research program in the field of controlled thermonuclear fusion is illustrated in detail. Firstly, a description is given of the major activities, which are carried on by Laboratori Gas Ionizzati at Frascati, in the frame of a CNEN-Euratom association, and are mainly oriented towards the magnetic confinement line according to the Tokamak approach and aimed at the construction of an experimental machine of this type. The activities developed by CNR Groups at the Milan and Padua Universities, in the frame of a CNR-Euratom association, are also described. At last, the present status and the perspectives are

examined of the Italian contribution to a possible European program, aiming at the construction, within 1990, of a Tokamak-type experimental reactor. (auth)

28449 NEW METALS FOR THERMONUCLEAR FUSION REACTORS. Watanabe, R. (National Research Inst. for Metals, Tokyo). Shin Kinzoku Kogyo; 18: No. 4, 85-92(Apr 1973). (In Japanese).

Radiation damage of vacuum wall construction materials are classified as internal or external. The main damage is caused by swelling and embrittlement. There are many studies on the metals having fcc and hcp structure, but few on the metals having bcc structure with high melting points. Further, there is very little information as to the behavior of the vacuum wall at energy levels as high as 14 MeV and at temperatures as high as 1,000°C. Studies on the metals and alloys of niobium, vanadium, molybdenum, and the like are reviewed. Blanket materials of lithium that can also be used as breeding materials as well as coolant are not yet established. Metallic lithium has too large an electric conductivity to flow across strong magnetic fields. V_3Ga has the best superconductive properties. (JA)

28450 LASER GENERATOR. De Wavrechin, R. (to Compagnie Generale d'Electricite). US Patent 3,798,567. 19 Mar 1974. Priority date 23 Jun 1971, France. 4p.

The positions of the reflector and the optical element are regulated with respect to the active medium through a sleeve which surrounds a portion of the optical resonant cavity of a laser generator. (Official Gazette)

Wave Phenomena

28451 (CEA-R-4537) STOCHASTIC KINETIC THEORY OF THE INTERACTION OF AN ELECTRON PLASMA WITH AN ELECTROMAGNETIC WAVE. di Bona, G. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Mar 1974. 101p. (In French). Dep. NTIS (U. S. Sales Only) $7.25.

Thesis. Submitted to Paris Univ., Orsay (France).

The interaction of an electron plasma with a high frequency electromagnetic field is studied using the Stratonovitch stochastic method. A hierarchy of equations is obtained. A small dimensionless expansion parameter is used to break this hierarchy. A set of two equations governing the system is obtained. The solution of this set of equations leads to the computation of the friction and diffusion terms of the equation describing the behavior of the one particle distribution function. Three kinetic equations are obtained depending on the value of the expansion parameter, i.e., two for the weak electromagnetic field and one for the strong electromagnetic field. (auth)

28452 (LRP-66-73) STUDY OF THE EIGENMODES OF A CYLINDRICAL PLASMA WITH THE FINITE ELEMENT METHOD. Appert, K.; Berger, D.; Gruber, R.; Troyon, F.; Rappaz, J. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Sep 1973. 22p. (In French). Dep. NTIS (U. S. Sales Only) $4.25.

The eigenmodes of a cylindrical homogeneous plasma may be calculated analytically. There are three classes of solutions. The eigenvalues of the first class are well separated, those of the second class have a point of accumulation. The eigenvalue of the third class is infinitely degenerated. The eigenvalues and eigenmodes of the corresponding discrete finite element problem tend towards the true solution. The convergence properties are discussed. (auth)

28453 (LRP-71-73) PARAMETRIC EXCITATION OF ALFVEN AND ACOUSTIC WAVES. Nguyen The Hung. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Oct 1973. 19p. Dep. NTIS (U. S. Sales Only) $4.00.

The nonlinear interaction between two Alfven waves and a sound wave was studied, using the normal mode approach. This leads, in a simple way, to a set of coupled equations, and consequently to a dispersion relation for the waves under consideration. It is shown that a large amplitude Alfven wave can give rise to two distinct types of parametric instabilities, namely the oscillating and the purely growing waves. In each case, the expressions for the threshold pump intensity, the frequency shift, and the growth rate of the excited waves are obtained. In particular, the results for a propagating pump under perfect frequency matching conditions are compared with those of Sagdeev and Galeev. (auth)

28454 (ORO-4338-3) NONLINEAR ELECTROSTATIC ION WAVES. Annual Progress Report. Jones, W. D.; Oleson, N. L. (University of South Florida, Tampa (USA). Dept. of Physics). 1 Feb 1974. Contract AT(40-1)-4338. 50p. Dep. NTIS $4.50.

Several experiments have been done during the period covered by this report. These experiments fall in the categories of both linear and nonlinear ion acoustic waves, pseudowaves, and plasma diagnostics. In addition, two new plasma facilities are being planned, with the construction of one being well underway. Although the experiments fall predominantly in the linear regime, the results obtained have strong implications for understanding the low-frequency behavior of hot, dense, turbulent, Vlasov plasmas in which strong density gradients, large-amplitude AC electric fields, and coherent particle motion predominate. (MOW)

28455 (SLA-73-1072) RADAR BACKSCATTERING BY A RANDOM PLASMA SLAB. Brown, W. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 39p. Dep. NTIS $4.00.

The scattering of a radar wave which is normally incident on a turbulent plasma slab whose properties vary only in the direction of incidence is examined. A formulation which separates the contributions of the fluctuating properties of the plasma to the scattering from the contributions of the ensemble averaged properties is developed. The formulation is then specialized so that the contributions of the ensemble averaged properties are taken into account in an eikonal approximation and the contributions of the fluctuating properties are described by a multiple scattering expansion in which an eikonal Green's function describes the propagation of the electromagnetic wave between scatterings. This specialized formulation is called the Born-eikonal formulation. Expressions are derived for the eikonal electric field functions, the eikonal Green's functions, and the ensemble averaged scattering cross section in the Born-eikonal formulation. A random plasma slab model is introduced for the purpose of comparing numerically the Born approximation, the Born-eikonal formulation, and the exact results. The calculations were performed for a range of radar frequencies and for a variety of values of the parameters characterizing the plasma slab. The predictions of the Born-eikonal approximation to lowest order in the multiple scattering expansion were almost always closer to the exact results than were the predictions of the Born approximation. The predictions of the Born-eikonal series to the fourth order in the electron density fluctuations were usually closer to the exact results than were the lowest order Born-eikonal predictions. (auth)

28456 SECULAR FREE SOLUTIONS UP TO THIRD ORDER FOR TWO CIRCULARLY POLARIZED WAVES IN A DISSIPATIVE PLASMA MEDIUM. Chandra, S. K. (Krishna Chandra Coll., West Bengal, India). Czech. J. Phys.; 24: No. 1, 72-76(1974).

The perturbation method of Lindstedt is applied to study the nonlinear effects for two circularly polarized transverse monochromatic waves in a cold dissipative plasma. Amplitude-dependent wavelength and frequency shifts including relativistic corrections are derived. (auth)

28457 COUPLED FIELDS IN STRATIFIED PLASMAS WITH TENSOR PRESSURE PERTURBATIONS. II. Anderson, W. C.; Burman, R. (Univ. of Western Australia, Nedlands). Czech. J. Phys.; 24: No. 1, 66-71(1974).

Small amplitude waves, described by Maxwell's equations and single-fluid hydrodynamics, in horizontally stratified, continuously varying plasmas with anisotropic electron pressure perturbations are discussed. A set of coupled wave equations in first-order matrix form, which describes two different types of obliquely propagating horizontally polarized transverse waves, is treated by the method of Clemmow and Heading. It is then transformed by Heading's method into a form which is valid throughout reflection regions, and from which a pair of second-order coupled wave equation in Foesterling's form follows. (auth)

28458 DISPERSION AND CYCLOTRON DAMPING OF PURE ION BERNSTEIN WAVES. Schmitt, J.P.M. (Laboratoire de Physique des Milieux Ionisés, Ecole Polytechnique, Paris, France). Phys. Rev. Lett. 31: No. 16, 982-986 (15 Oct 1973).

Ion Bernstein waves are excited by a long wire in the center of a potassium Q-machine plasma column. Because the wave vector is very nearly perpendicular to the magnetic field, we observe pure ion Bernstein waves, in contrast to neutralized ion Bernstein waves which were previously observed. The frequency bands for the cyclotron damping are so narrow that we can distinguish the isotopes of potassium. (auth)

28459 NONLINEAR ABSORPTION OF RADIATION BY OPTICAL MIXING IN A PLASMA. Fuchs, V.; Neufeld, C.R.; Teichmann, J.; Englehardt, A.G. (Institut de Recherche de l'Hydro-Québec, Varennes, Québec, Canada). Phys. Rev. Lett. 31: No. 18, 1110-1113 (29 Oct 1973).

Parametric excitation of longitudinal plasma oscillations can occur when a plasma is simultaneously irradiated by two laser beams whose

frequencies differ by (2/n) ω_{pe}, n = 1, 2, 3, . . . , where ω_{pe} is the electron plasma frequency. We examine (i) the effect of a frequency mismatch on the excitation of the principal mode, (ii) the mode coupling in an inhomogeneous plasma, and (iii) the radiation absorption efficiencies. (auth)

28460 STIMULATED SCATTERING OF LIGHT BY PLASMONS AT LARGE GRADIENTS OF THE MEDIUM DENSITY. Strel'tsev, V. N. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 8, 314-315(20 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 8, 532-535(20 Oct 1973).

Stimulated Raman scattering by electron Langmuir oscillations is considered at large gradients of the plasma density. It is shown that the scattered Stokes component is amplified in this case only in a definite interval of angles between the direction of the density gradient of the medium and the wave vector of the pump wave, and is proportional to the characteristic length of the plasma inhomogeneity. (auth)

28461 EXCITATION OF SOLITARY WAVES IN A BEAM–PLASMA SYSTEM. Fedorchenko, V. D.; Mazalov, Yu. P.; Bakal, A. S.; Pashenko, A. V.; Rutkevich, B. N. (Physical-Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.); 18: No. 8, 281-282(20 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 8, 477-480(20 Oct 1973).

Solitary space-charge waves are produced in a plasma–beam system by modulating the beam and by amplifying and transforming the initial spectrum. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 26950, 27372, 27373, 27642–27645, and 27681.

28462 (AD-766230-7) TIME-DEPENDENT TRANSPORT VIA THE CONTINUED FRACTION APPROXIMATION. Technical Report, January 1972–May 1973. Yingling, W. A. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Jul 1973. 126p. (AFWL-TR-73-143). NTIS $4.50.

The time-dependent neutral particle transport problem of an isotropic Green's function source in homogeneous, isotropic, spherically symmetric media is examined using the infinite set of time-dependent P–N equations and integral transform techniques. The approximate Green's function solutions in transform space for the all-angle flux corresponding to the P–N approximation of order N are determined to order P-9, and demonstrate a multiple wave nature upon inversion. An examination of the set of P–N solutions leads to the development of the complete (P-infinity) continued fraction solution in transform space. For pure absorbing media the continued fraction is related to an analytic function which, upon inversion, yields the exact analytical solution to the problem. For cases with low-order scattering moments the continued fraction solution yields closed form functions in transform space, but these have not yielded to useful inversion. However, a continued fraction approximation technique is developed and yields simple closed form approximate solutions for the case of isotropic scatter. (GRA)

28463 (AD-766889-0) TIME-DEPENDENT TRANSPORT VIA THE CONTINUED FRACTION APPROXIMATION. Yingling, W. A. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Jun 1973. 124p. (DS/PH-73-1). NTIS $4.25.

Thesis.

The time-dependent neutral particle transport problem of an isotropic Green's function source in homogeneous, isotropic, spherically symmetric media is examined using the infinite set of time-dependent P-N equations and integral transform space for the all angle flux corresponding to the P-N approximation of order N are determined to order P-9, and demonstrate a multiple wave nature upon inversion. An examination of the set of P-N solutions leads to the development of the complete (P-infinity) continued fraction in transform space. (GRA)

28464 (COO-3427-6) NUCLEAR CHEMISTRY RESEARCH. Annual Progress Report, 1 January–31 December 1973. Wolke, R. L. (Pittsburgh Univ., Pa. (USA). Wherrett Lab. of Nuclear Chemistry). 1973. Contract AT(11-1)-3427. 46p. Dep. NTIS $4.50.

Work is reported in the following areas: calculation of electron capture and loss cross section of ^{11}B in B; determination of ^{6}Li and ^{9}Be charge states; solution of the capture–loss equations for the cross sections; capture–loss cross sections of B and C ions; charges of recoils from heavy-ion reactions; and search for alpha activity in medium-heavy elements. Advances in experimental techniques are also recounted. Four of the papers are separately title listed. (RWR)

For title listings of individual papers see: 27680, 28307, 28465, and 28466.

28465 (COO-3427-6, pp 19-27) CHARGES OF LITHIUM AND BERYLLIUM RECOILS; ANALYTICAL SOLUTION OF ELECTRON CAPTURE–LOSS EQUATIONS. 1973.

In nuclear chemistry research.

28466 (COO-3427-6, pp 33-35) RECOILS FROM $^{197}Au(^{16}O, ^{16}O)^{197}Au$ ELASTIC SCATTERING. 1973.

In nuclear chemistry research.

28467 (FDA-74-8008) 5TH ANNUAL NATIONAL CONFERENCE ON RADIATION CONTROL, PORTLAND, OREGON, MAY 6–10, 1973. Planning for Protection. (Bureau of Radiological Health, Rockville, Md. (USA); Environmental Protection Agency, Washington, D. C. (USA). Office of Radiation Programs). Oct 1973. 373p. (CONF-730584-).

This publication contains the proceedings of the Fifth Annual National Conference on Radiation Control—Planning for Protection—May 6-10, 1973, in Portland, Oregon. Participants representing State and major local radiation control programs, as well as Federal agencies, discussed mutual radiation control programs. "Planning for Protection" was the theme, which considered a number of approaches to reducing radiation levels in our society, and at the same time, improving the use of radiation forms in improving our environment, our health, our lives, and our livelihoods. In addition to formal presentations and educational seminars, the proceedings contain the reports of Workshops and Resolutions by the Conference of Radiation Control Program Directors. (auth)

28468 (INIS-mf-1029) RADIATION HEALTH AND SAFETY. Annual Report for the Year Ended 31st December 1972. (New South Wales Univ., Kensington (Australia)). 1973. 17p. INIS.

Aspects of radiation health and safety under the auspices of the radiation protection officer are reviewed for the year 1972. Topics include personnel monitoring, radioactive waste disposal, radiation incidents, radiation insurance, advisory services and research. Radioactive materials and apparatus received are listed together with materials on order. Film badge exposures are tabulated. (INIS)

28469 (ORNL-TM-4462) CALCULATED PARTICLE-PRODUCTION SPECTRA FROM π^- CAPTURES IN TISSUE, TISSUE-EQUIVALENT PLASTIC, SILICON, AND GERMANIUM. Armstrong, T. W.; Chandler, K. C. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974 Contract W-7405-eng-26. 51p. Dep. NTIS $4.75.

An intranuclear-cascade-evaporation model has been applied to predict the energy spectra of the products (neutrons, protons, deuterons, tritons, ^{3}He's, alpha particles, and residual nuclei) from π^- capture in several materials (tissue, tissue-equivalent plastic, silicon, and germanium) of interest in pion dosimetry. Also, the energy spectra of the products from 90-MeV π^- interactions in tissue are computed. (auth)

28470 (ORNL-TM-4499) CALCULATIONS ON TISSUE EQUIVALENCE FOR STOPPING π^- MESONS. Armstrong, T. W.; Chandler, K. C. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 23p. Dep. NTIS $3.25.

Calculations have been made of the energy deposition in tissue-equivalent plastic (Shonka type A-150) and tissue when both are placed in the stopping region of a negatively charged pion beam. The configuration considered is that of relatively small pieces of tissue-equivalent plastic (thicknesses of 50 and 3000 microns) placed in a large π^- capture region. The multiplicities and energies of the π^- capture products were determined using an intranuclear-cascade-evaporation model, and the energy deposition was obtained using computed stopping powers and ranges. (auth)

28471 COMMENTS ON THE THEORY OF RADIATION RISK. Parts 1 and 2. Neufeld, J. (European Organization for Nuclear Research, Geneva). Health Phys.; 26: No. 3, 229-243(Mar 1974).

Part 1 presents a systematic outline of the current theory of radiation risk. The most basic ideas of the theory can be expressed by two quantities that represent the administrative approach to radiation risk. These quantities are specific dose, D_s, that relates to individual organs or tissues and overall dose, D_b, that relates to the entire human body. By taking D_s and D_b as a starting point and by using postulational methods, two auxiliary quantities were derived that are dose equivalent, $D_e(r)$, and quality factor, Q. Dose equivalent, $D_e(r)$, is a macroscopic field quantity and is, therefore, different from the ICRP defined dose equivalent, H, which is microscopic. In Part 2 an experimental program and a computational program are outlined for obtaining a relationship between Q and linear energy transfer, L. It is shown that by applying Monte Carlo procedures one can determine distributions of L in critical organs of animals exposed to ionizing radiations. Then, using biological data for critical effects (extrapolated from high radiation levels to presumed effects at low levels), sets of linear equations can be obtained in which the coefficients are the doses delivered in intervals of L, and the unknowns are biological weighting factors, λ. From these equations one can derive λ's for various L's as they relate to critical effects in animals. Then, using value judgment and combining the calculated results with data observed on men, one can obtain a Q–L relationship that is more directly based on experimental evidence than that which is currently used. (auth)

28472 PENETRATION OF LOW-ENERGY POSITRONS THROUGH THIN METALLIC FOILS. Spanel, L. E.; Rupaal, A. S.; Patrick, J. R. (Western Washington State Coll., Bellingham). Phys. Rev., B; 8: No. 9, 4072-4074(1 Nov 1973).

The penetration of positrons (0.544-MeV maximum) from a ^{22}Na source through absorber foils of Al, Cu, Sn, and Au was measured in vacuum (10^{-3} torr). It was found that the transmitted-positron intensity decreases exponentially with the thickness of the absorber over different ranges of transmission for different absorbers. Measurements on Al foils were performed at atmospheric pressure and vacuum to determine the effect of the air path on the mass-absorption coefficient. It was found that the onset of the exponential absorption occurs at a higher relative transmission value when the experiment is performed in air. However, there is no significant effect on the slope of the straight-line portion of the graph which is proportional to the value of the mass-absorption coefficient. At transmitted-positron intensities below 4%, the Z dependence can be described by $t/A = KZ^{-\frac{1}{2}}$, where t is the thickness in mg/cm^2, A is the mass of the atom, and K is a constant. (auth)

28473 ENERGY LOSS BY CHARGED PARTICLE IN UNIAXIAL TRANSPARENT CRYSTAL. Kukanov, A. B.; Konstantinovich, A. V. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 4, 491-493(1973). (In Russian).

Formulas are given for the description of the energy loss by the movement of particles along helical lines in a transparent uniaxial crystal. It is shown how, from these formulas, formulas can be obtained for the intensity of the Vavilov–Cherenkov radiation of charged particles moving at an arbitrary angle to the optic axis of the crystal. (JSR)

28474 EFFECT OF IONIZATION LOSS ON THE STRUCTURE OF THE THREE-DIMENSIONAL SCATTERING OF ELECTRONS NEAR THE AXIS OF THE CASCADE SHOWER. Roganova, T. M. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 4, 456-460(1973). (In Russian).

The three-dimensional distribution functions of shower electrons with energy $E > 0$, occurring at a depth t in a circle of radius R from the axis of a shower with total energy E_0, were obtained in the b approximation of three-dimensional cascade theory. A comparison was made with the corresponding functions calculated with the "axial" approximation. The error in the measurement of the energy E_0 by the axial approximation method was evaluated as a function of the ratio E_0/β, depth t, and radiation length units. (4 graphs) (tr-auth)

28475 INTEGRAL ABSORBED DOSE IN NEUTRON-CAPTURE THERAPY. Ivanov, V. N.; Ivanova, L. F.; Parfenov, E. N.; Ryabukhin, Yu. S. Med. Radiol.; 19: No. 1, 50-55(Jan 1974). (In Russian).

The Monte-Carlo method was used to calculate integral absorbed doses inside the beam and outside its geometrical boundaries in the tissue 30 cm thick for beams with circular section and radius of 0.5, 1.5, 2.5, 4.5, and 6.5 cm and neutron energy of 1 MeV, 500 keV, and 100 eV. The energy distribution was calculated individually for each component of the integral absorbed dose from nuclei of recoil and products of the reaction $^1H(n,\gamma)\,^2H$ and $^{14}N\,(n,p)\,^{14}C$. Values of the integral absorbed dose for neutrons with different initial energy indices with the absorbed dose of 100 rad on the surface of the tissue are given. Such information is necessary for solving dosimetric problems of neutron-capture therapy. (auth)

28476 CALCULATION OF THE DOSE FIELD OF ELECTRON IRRADIATION IN HOMOGENEOUS MEDIUM. Kozlov, A. P.; Shishov, V. A.; Rotenberg, M. Z. Med. Radiol.; 19: No. 1, 64-69(Jan 1974). (In Russian).

A method for the calculation of the dose field of electron irradiation in homogeneous medium is examined. The method is based on the summation of the dose distribution of infinitely narrow beams. (JSR)

28477 METHOD OF COMPARISON OF DOSE FIELDS. Denisenko, O. N.; Kozlov, V. A.; Parfenov, E. N. (Scientific Research Inst. of Medical Radiology, Moscow). Med. Radiol.; 19: No. 1, 61-64(Jan 1974). (In Russian).

Metrics of uniform approximation are suggested for comparing two dose fields. They consist in finding a maximum absolute value of the compared fields doses. When comparing relative dose fields it is recommended that these fields be standardized by their maximum value. (auth)

28478 NEWEST METHOD OF FINDING OPTIMAL CONDITIONS FOR IRRADIATION BY A RAZDAN-3 TYPE COMPUTER. Parfenov, E. P.; Denisenko, O. N. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 19: No. 1, 56-61(Jan 1974). (In Russian).

The possibility of using the newest method on a computer is shown. A special program was compiled for the Razdan-3 computer that was based on the analysis of positive and negative values of differential fields of iterations. The given clinical examples show that the program can be successfully used for making up schedules of irradiation. (auth)

28479 BASIC PHYSICS. Fosmark, H.; Johansen, J.; Klokk, A.; Strickert, T.; Aamlid, H. (Statens Institutt for Straalenhygiene, Oslo). pp 9-78 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

A cursory treatment of the elementary physics concepts leads to a discussion of energy and wave physics, electromagnetic waves, and x-radiation. The nature of x-radiation and its properties are then discussed, and some characteristics of x-ray tubes explained. The absorption and scattering of x-radiation is discussed, and finally the units commonly used in ionizing radiation are defined and explained. (JIW)

28480 BETWEEN WAVE AND PARTICLE. Semiclassical Method for Interpreting High-Energy Electron Micrographs of Crystals. Berry, M. V.; Boxton, B. F.; Ozorio de Almeida, A. M. (Univ. of Bristol, Eng.). Radiat. Eff.; 20: No. 1-2, 1-24(1973).

The concepts of "semiclassical mechanics" are applied to the propagation of an electron beam through a crystal lattice. A variety of approximate descriptions are obtained which bridge the gap between the full quantum treatment necessary at lower voltages and the purely classical analysis which becomes valid at higher voltages. These methods, which are all based on "real space", lead to simple physical descriptions and numerically accurate formula for phenomena which have previously only emerged after lengthy computations based on Fourier analysis: examples are the existence of "critical voltages" and "critical angles". It is shown how the purely classical concept of "caustic" can explain features on micrographs which are usually considered as interference fringes; this bypasses the need to construct "dispersion surfaces". Absorption from the diffracted beams, which is caused by inelastic scattering, is incorporated into the semiclassical analysis. (auth)

28481 EXPERIMENTAL INVESTIGATIONS ON DEPTH DOSE DISTRIBUTION IN IRRADIATION WITH ULTRAHARD X RAYS OF 25, 35, AND 42 MeV. Hoffmann, E. Mannheim, Ger.; Univ. Heidelberg (1972). 47p. (In German).

Thesis.

The depth dose distribution was measured for 25, 35 and 42 MeV x rays with different focus-skin-distances and field widths. With a Siemens betatron, a water-equivalent phantom and three parts (skull, chest and pelvis) of a nearly body-equivalent phantom (ALDERSON RANDO) were irradiated. For the deep x-ray therapy with focal depths of more than 8 cm 42 MeV x rays are more suitable than Cobalt-60 gamma rays. (GE)

28482 MODEL FOR EXPOSURE TO A SEMI-INFINITE CLOUD OF A PHOTON EMITTER. Poston, J. W.; Snyder, W. S. (Oak Ridge National Lab., TN). Health Phys.; 26: No. 4, 287-293(Apr 1974).

The dose from a semi-infinite cloud of a photon-emitting radionuclide is an idealization of an exposure situation, but it is a useful one, particularly for noble gases of long radioactive decay half-times, e.g. ^{85}Kr. An analysis is presented of absorbed dose to body organs for monoenergetic photons emitted in an infinite cloud. Twelve photon energies in the range 0.01 to 4 MeV were used in these calculations, and the concentration in the cloud was considered uniform. The energy spectrum of scattered photons is first calculated by the method of Dillman (to be published), and the resulting fluence is used as the source on an anthropomorphic phantom, essentially as considered in MIRD Pamphlet No. 5 (Snyder et al (1969)). The dose to the various organs is obtained by the Monte Carlo technique. Also a method is described which provides estimates of absorbed dose to organs by use of calculated depth dose profiles in the phantom. This method is used for those organs for which the coefficient of variation of the Monte Carlo estimate exceeded 30%. It is expected that dose from photons emitted in the decay of a real radionuclide could be obtained by interpolation from these results. (auth)

28483 RADIATION PROTECTION IN USE OF MEDICAL X-RAY DEVICES. Ullrich, H. (Zentralverband der Elektrotechnische Industrie, Erlangen, Ger.). Arbeitsschutz (Cologne); No. 4, 165-168(1973). (In German).

From the viewpoint of the German manufacturers of medical x-ray devices, those radiation protection characteristics are discussed which are contained in paragraphs 3, 4, 5, 6, 8, 12, 13, 16, 19, 24, 25, 28, 29 and 38 of the new x-ray ordinance. (GE)

28484 APPROXIMATION FOR THE TRANSPORT EQUATION. Puzin, M. Compt. Rend., Ser. A, B; 277: No. 13, 637-640(1 Oct 1973). (In French).

A plane source emitting photons is considered. The numerical equation for the flux transport controlling the diffusion of these photons across a flat plate parallel to the source and of finite thickness is given for the case when only photoelectric effects and Compton pair production are taken into account. A simple noniterative method is suggested for resolving this equation. (FR)

28485 TRANSMISSIONS OF ELECTRONS WITH ENERGIES OF 0.5 TO 4 keV THROUGH THIN METAL FILMS. Vyatskin, A. Ya.; Trunev, V.V.; Fitting, Kh. I. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 18: No. 2, 317-319(Feb 1973).

Translated from Radiotekh. Elektron.; 18: No. 2, 432-433 (Feb 1973).

The transmission, reflection, and absorption of electrons with initial energies E_0 = 0.5 to 4 keV in aluminum and beryllium by bombardment of thin films are reported. A simple three-electrode system with collectors of 2 π-geometry was used. The secondary electron emission from the target and collector was suppressed with suppressor grids with a negative potential of −50 V. (MHR)

28486 DOSIMETRY OF NEUTRON BEAMS OF A REACTOR IN RADIOBIOLOGICAL EXAMINATIONS. Ivanov, V. N.; Ryabuchin, Yu. S.; Letov, V. N.; Ivanova, L. F. (Inst. of Medical Radiology, Moscow). Radiobiol.–Radiother.; 14: No. 5, 557-568 (1973). (In German).

The depth distribution of tissue dose and of its components in the irradiation of a body phantom of man with neutrons from horizontal channels P-2 and B-3 of the reactor BR-5 was investigated. The tissue dose at the phantom surface could be shown to be produced essentially by recoil nuclei. In the phantom depth the contribution of these particles highly decreases whereas the portion of the tissue dose due to the reaction ^{1}H (n, γ) ^{2}H and to the gamma radiation of the reactor appropriately increases. The proton dose of the reaction ^{14}N (n, p) ^{14}C is unimportant and does not exceed 2 to 3% of the total dose. The measuring results are compared with the values calculated for wide and narrow neutron beams. The comparison shows that size and spatial distribution of the single components and of the total tissue dose considerably depend on the diameter size of the real beam. The mean tissue dose rates in mice "free air" were measured at the channel exit and in different phantom depths. They were compared with the calculated dose rates which were calculated by integration of depth dose in the phantom for neutrons having the spectrum of the channel P-2. (auth)

28487 β-RADIATION MASS ATTENUATION COEFFICIENT AS A FUNCTION OF MATERIAL PROPERTIES. Thuemmel, H. W. (Zentralinstitut fuer Isotopen- und Strahlenforschung, Leipzig). Isotopenpraxis; 9: No. 9, 331-333(Sep 1973). (In German).

Studies supporting the work of Crowder on the Z dependence of the β radiation mass attenuation coefficient are cited. (JSR)

28488 EXTENDING THE GENERAL FIELD EQUATION TO FIT THE DOSE DISTRIBUTIONS OF A VARIETY OF THERAPY UNITS. Weinkam, J. J.; Kolde, R. A.; Sterling, T. D. (Washington Univ., St. Louis). Brit. J. Radiol.; 46: No. 551, 983-990 (Nov 1973).

The general field equation was originally developed for the Eldorado A therapy unit and was easily extended to other similar cobalt units. Attempts to fit the general field equation to dose data for more recent cobalt units or other energy sources have resulted in less accurate dose determinations. A single equation is derived which is able to represent satisfactorily the dose distribution of the following therapy units: Theratron F, Theratron 80 or Eldorado 8, Gammatron 3, Picker C8, Picker C9, Varian 6, and a 22 MeV betatron. (auth)

28489 METHOD OF MAPPING RADIOACTIVITY DISTRIBUTION IN BODIES. Fronka, O.; Pavlicek, Z. Czech Patent 145,176. 15 Sep 1972. Filed Date 16 Nov 1971. 2p.

The method of mapping the radioactivity distribution in bodies is based on the effect of radioactive radiation emitted by a body, on a layer of exoemissive substance coated on a carrier to which the tested body is pressed. On completing the exposure the layer is separated from the body, and the exoelectron emission induced by radioactive radiation is measured using a gas counter. The duration of the exposure depends on the absolute value of the body activity. The method is well suited mainly for the determination of the distribution of low activity in the surface layers of a body. (Nuclear Sci. Abstr. Czech.)

28490 SOME PROBLEMS IN THE DOSIMETRY OF X IRRADIATION APPLIED IN BIOLOGICAL EXPERIMENTS. Dosay, K.; Koczkas, G.; Bojtor, I. (Orszagos Frederic Joliot–Curie Sugarbiologiai es Sugaregeszsegugyi Kutato Intezet, Budapest). pp 311-313 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From first European biophysics congress; Baden, Austria (14 Sep 1971).

Technical and dosimetric ideas connected with the irradiation of biological objects are reviewed. Attention is called to the possibility of improving isodose distribution by a certain technique eliminating the necessity of rotating the irradiated animals (objects). Authors insist that the bottom of the boxes for the irradiation of small animals should not be plane but shaped according to an appropriate spherical radius. Critical comments are made on the bilateral irradiations and on the irradiation of biological thin layers and germinating seeds. They suggest problems for study, as the homogeneity of radiation energy and dose distribution. They deal with the irradiation field and scattered radiation as well as with the application of compensating filters. (auth)

28491 PHYSICS DATA IN RADIATION HYGIENE. Flateby, J. (Statens Institutt for Straalenhygiene, Oslo). pp 177-205 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

Radiation physics parameters and data which form the basis for calculation of x-ray radiation doses, scattering, shielding, etc. are discussed, commencing with radiation quality and filtering. The radiation yield from x-ray tubes is then shown to be related to the tube current, high tension, voltage characteristics, anode material and filtering. Secondary radiation due to Compton scattering and the photoelectric effect is discussed, first generally, then with reference to secondary radiation from a patient. Primary and secondary shielding are discussed and calculation of shielding required illustrated in a table. The arrangement of shielding in x-ray laboratories is then considered and examples of calculations and arrangements are given. (NO)

28492 X-RAY MASS ABSORPTION COEFFICIENTS FOR Au, Pb, AND Bi IN THE RANGE 1 TO 10 A. Woodhouse, J. B.; Fields, A. L. A.; Bucklow, I. A. (Metals Research Ltd., Royston, Eng.). J. Phys., D (London); 7: No. 3, 483-489(11 Feb 1974).

Experimentally determined mass absorption coefficients for wavelengths from 1 to 10 A in Au, Pb, and Bi are presented in tabular form; an accuracy of ± 3% is claimed. The tables contain both new and revised data which are compared with values published by Heinrich (The Electron Probe (New York,Wiley) 296-277 (1966)). (auth)

28493 RADIATION PROTECTION OF PATIENTS IN MEDICAL X-RAY APPLICATIONS. Flateby, J. (Statens Institutt for Straalenhygiene, Oslo). pp 232-248 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

Radiological techniques which reduce the radiation dose to patients are discussed and illustrated. The use of filters and shielding and the significance of the distance from focus to skin are considered. The use of high voltage techniques is also mentioned. The various possibilities in photographic registration, image intensification and direct viewing are discussed with reference to reducing the dose to the patient. Protection of critical organs, such as the gonads, is discussed and finally brief considerations of developing, work routine and dosimetry are given. (NO)

28494 RADIATION SAFETY AND RADIATION HYGIENE IN DENTAL RADIOGRAPHY. Moe, A. M. (Statens Institutt for Straalenhygiene, Oslo). pp 256-258 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

The control and inspection of dental x-ray apparatuses is outlined. The shielding requirements are presented and techniques and recommendations for reducing the radiation doses to both patients and operators are discussed. (NO)

28495 RADIATION PROTECTION IN MEDICAL USE OF RADIOISOTOPES. Berthelsen, T. (Statens Institutt for Straalenhygiene, Oslo). pp 249-255 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

Dose calculations for external and internal irradiation from the use of radioisotopes in medicine are presented. Thereafter radiation protection measures in the use of radioisotopes are discussed. (NO)

28496 RADIATION PROTECTION OF PERSONNEL IN MEDICAL X-RAY APPLICATIONS. Flateby, J. (Statens Institutt for

Straalenhygiene, Oslo). pp 206-231 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

Recommendations for procedures and use of technical aids to reduce the radiation doses to medical personnel when using x-radiation in diagnosis or therapy are given. This includes the use of protective clothing, safety equipment on the apparatus and working techniques, including holding of patients. Typical isodose curves from various apparatus types and positions during radiography are given. (NO)

28497 INVARIANT IMBEDDING AND RADIATION DOSIMETRY. VII. Finite Order Scattering and Transmission Functions of the Two Radiation Approximations in a Target Slab. Bellman, R.; Ueno, S.; Vasudevan, R. (Univ. of Southern California, Los Angeles). Math. Biosci.; 18: No. 3-4, 255-268(Dec 1973).

The two component radiation approximation for the calculation of absorbed dose when γ radiation passes through irradiated material is treated. A method of solving in a successive fashion the vector transfer equation for the two component radiation is described. A two-by-two matrix is used to represent the differential attenuation coefficient. Employing the imbedding principle, a set of integro-differential recurrence relations for the two-by-two matrices of finite order, scattering and transmission functions is obtained. Making use of these functions, the two component radiation field within the homogeneous, anisotropically and noncoherently scattering target slab (Bellman, Ueno, and Vasudevan, to be published), can be computed. This enables us to determine the absorbed dose. (auth)

28498 INITIAL RADIAL DISTRIBUTION OF EXCITED STATES PRODUCED BY DELTA-RAYS EJECTED BY A 300 keV PROTON IN WATER VAPOR. Miller, J. H.; Green, A. E. S. (Univ. of Florida, Gainesville). Radiat. Res.; 57: No. 1, 9-19(Jan 1974).

A microscopic approach based upon the assignment of electron impact cross sections has been used by Green et al. to calculate the efficiencies for degradation of low energy electrons in water. By Monte-Carlo techniques Berger has calculated the spatial distribution of the total energy deposited by δ-rays ejected at various energies and at various angles with respect to a heavy ion beam. Here a model is developed which combines these two results to calculate the energy per unit volume deposited in various excitations of the H_2O molecule by δ-rays ejected by a 300 keV proton. Results are presented for vibrational excitations, electronic excitations, and ionization continua as a function of the radial distance from the proton beam. (auth)

28499 ABSORBED FRACTIONS FOR SMALL BODIES: THE CUBE-ROOT-OF-MASS DEPENDENCE. Hubbard, L. B. (Furman Univ., Greenville, SC). Radiat. Res.; 57: No. 1, 1-8(Jan 1974).

When the absorbed fraction for internally emitted gamma rays is calculated in the approximation, neglecting both beam attenuation and scatter buildup, the absorbed fraction is proportional to the cube root of the mass. It is generally assumed that this approximation holds only for bodies whose linear dimensions are much less than the mean free path of the primary photons. Here, it is shown that the validity of this approximation holds to larger sizes. In particular, absorbed fractions as large as 0.2 will be calculated with an error of less than 10% for energies sufficiently far from the minimum of μ_{en}/μ ($E \lesssim 40$ keV or $E \gtrsim 0.1$ MeV for a body in space, or $E \lesssim 30$ keV or $E \gtrsim 0.2$ MeV for a body embedded in scattering media). (auth)

28500 INVESTIGATIONS ON THE DOSE DISTRIBUTION IN PENDULUM TRANSLATION WITH TRANSVERSAL AXIAL SHIFT IN THE ANGLE BISECTOR DIRECTION WITH FAST TRANSLATIONAL MOTION. Cueppers, H. Heidelberg; Heidelberg Univ. (1973). 31p. (In German).

Thesis.

For a special therapeutical cobalt-60 method (defined in the title) the dose distribution was measured. The investigations were performed using a polystyrole phantom similar to the human body. For a constant displacement length of 9 cm, dose distributions for pendulum angles of 60° and 120° and field widths of 4, 6, and 8 cm were determined and the results presented in graphs. (GE)

28501 INVESTIGATIONS ON THE DOSE DISTRIBUTION IN CONCENTRIC PENDULUM IRRADIATION WITH ULTRA-HARD X RAYS (30, 35, 42 MeV). Gauwerky, C. Mannheim, Ger.; Univ. Heidelberg (1972). 73p. (In German).

Thesis.

Using hard x-rays (30, 35, 42 MeV), the dose distribution in pendulum irradiations is investigated. With the help of a 42 MeV-betatron the measurements were performed on a homogeneous, water-equivalent phantom. An optimum depth dose is obtained using small field widths and large pendulum angles. The merits of the pendulum method are a low dose before and behind the focus and a uniform dose distribution throughout the focal region. (GE)

28502 SIMPLE METHODS FOR CALCULATING THE GAMMA-RAY EXPOSURE UNDER A RADIOACTIVE PLUME. Oppermann, R.; Krueger, F. W. (VEB Kombinat Kraftwerksanlagenbau, Berlin). Kernenergie; 16: No. 10, 317-321(Oct 1973). (In German).

On the basis of a coarse cloud model some simple formulae for approximately calculating the gamma-ray dose rate under a radioactive plume have been derived. The applicability of these formulae has been proved by comparison with more exact calculations. The approximations requiring only a very low computational expense are shown to give results sufficiently exact for practical purposes. (auth)

28503 EXPERIMENTAL DETERMINATION OF THE IMPACT PARAMETER DEPENDENCE OF INELASTIC ENERGY LOSS OF CHANNELED IONS. Bulgakov, Yu. V.; Nikolaev, V. S.; Shulga, V. I. (Moscow State Univ.). Phys. Lett.; 46A: No. 7, 477-478 (11 Feb 1974).

Using the channeling technique, the impact parameter dependence of inelastic energy loss of fast He and N ions in Si has been measured. (auth)

28504 EXPERIMENTAL INVESTIGATIONS ON THE DOSE DISTRIBUTION IN ELECTRON-BEAM PENDULUM THERAPY OF THE HUMAN SKULL. Griss, M. Mannheim, Ger.; Univ. Heidelberg (1972). 49p. (In German).

Thesis.

The investigations show that the application of pendulum irradiation in the therapy of human brain neoplasms seems to be quite useful. It is possible to concentrate the maximum dose to the focus and the radiation dose to the healthy parts of the brain is essentially smaller than it would be in the case of photon irradiation or standing-field irradiation with fast electrons. Compared with the moving-field irradiation using ^{60}Co-γ-rays, the moving-field irradiation with fast electrons still offers advantages with regard to the dose distribution. (GE)

28505 CONSIDERATION OF SOME PROBLEMS IN DOSIMETRY AND RADIOBIOLOGY OF STOPPED NEGATIVE PIONS. Baarli, J. (European Organization for Nuclear Research, Geneva). Fortschr. Geb. Roentgenstr. Nuklearmed.; 120: No. 1, 98-103(Jan 1974).

The properties of the pion beams produced in the CERN 600 MeV synchrocyclotron are briefly described and some experimental results on depth dose distribution and isodose curves in water, on the stopping region and on RBE are dealt with. (GE)

Radiation Protection Standards

Refer also to abstract 27156.

28506 PARASITIC RADIATION EMITTERS AND THEIR TREATMENT IN THE NEW X-RAY ORDINANCE. Wehner, G. (Physikalisch-Technische Bundesanstalt, Brunswick). Arbeitsschutz (Cologne); No. 4, 186-192(1973). (In German).

For the first time, the new X-Ray Ordinance makes an attempt to regulate the radiation protection of all parasitic radiation emitters. The article discusses the procedures applied. A terminological definition of a parasitic radiation emitter is given first. After some general considerations on the formation process of parasitic radiation, a survey is given of current types of parasitic radiation emitters. The regulations of the X-Ray Ordinance to be observed are discussed in detail. Some proposals are made for the treatment of parasitic radiation emitters requiring licenses. (GE)

28507 INTERNATIONAL RECOMMENDATIONS, STANDARDS AND RULES AND THEIR RELATION TO THE X-RAY ORDINANCE. Muth, H. (Universitaet des Saarlandes, Homburg, Ger.). (1973). vp. (In German).

From fourteenth annual meeting of the Vereinigung Deutscher Strahlenschutzaerzte eV; Wuerzburg, Germany (16 Nov 1973).

The scientific fundamentals of the new radiation protection regulation and their influence on this regulation are discussed on the basis of the ICRP Recommendations, the Radiation Protection Standards of EURATOM, and the standards of the Specialist Committee on Standardization in Radiology. (GE)

28508 RATIONALE FOR RADIATION PROTECTION. Hurst, G. S.; Garrett, W. R.; Payne, M. G. (Oak Ridge National Lab., TN). Health Phys.; 26: No. 4, 313-318(Apr 1974).

Suggestions are made for a more quantitative rationale for radiation protection. Thus, an approach is discussed in which external fields, or the response of suitable detectors exposed

to the fields, are transformed into the time-dependent probabilities for specific biological effects in a given species. It is pointed out that detector and computer technologies are emerging which make such a system possible. Suggestions are offered for biological experiments which will maximize the usefulness of radiation effects data both in implementing the subject rationale and in the understanding of biological effects. (auth)

Radiation Source Calibration and Standardization

28509 (RT/PROT-(73)37) THERMAL NEUTRON FLUX DENSITY STANDARD WITHIN THE C.S.N. AT CASACCIA. Rotondi, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 24 Oct 1973. 42p. (In Italian). Dep. NTIS (U.S. Sales Only) $5.25.

A thermal-neutron flux density standard was built with six Am–Be neutron sources using graphite and polyethylene as moderating medium. The total neutron emission rate of the sources was 14.6×10^6 s^{-1}. The graphite was a cylinder 20 cm high and 25 cm in diameter, with a central cavity 10 cm high and 5 cm in diameter. The thermal neutron density in the cavity, measured by gold activation, yielded 1.220×10^4 cm^{-2} s^{-1} ± 0.7% with a cadmium ratio of 9.31 ± 0.05. An independent absolute measurement of the flux made by P.T.B. in Braunschweig, Germany, gave 1.217×10^4 cm^{-2} s^{-1} ± 0.9%. (14 figures, 2 tables) (auth)

28510 USE OF ^{129}I FOR EXPOSURE RATE CALIBRATION OF X-RAY INSTRUMENTATION. Golinick, D. A. (Univ. of California, Los Angeles). Health Phys.; 26: No. 4, 307-311 (Apr 1974).

Due to the limitations of several popular techniques for exposure rate measurements at low x-ray energies, it is suggested that encapsulated isotopic sources of ^{129}I be employed for calibration of monitoring equipment used under these conditions. This isotope emits a γ photon at 39.6 keV and two K x rays, at 29.6 and 34.0 keV, which result from the internal conversion of the excited state in xenon. Absolute photon intensities for these emissions were calculated to be 4, 62, and 14% respectively. These values were obtained using published internal conversion coefficients, fluorescent yields, and characteristic x-ray relative intensities. An encapsulated ^{129}I source of 1.4 μCi is described, and its exposure rate is calculated to be 0.155 mR/hr at 2.5 cm, compared to a measured value of 0.150 ± 0.020 mR/hr. A value of 0.069 ± 0.009 R/hr-Ci at 1 m was measured for the specific γ-ray constant for this isotope. (auth)

28511 METHOD FOR THE CALCULATION OF BETA-RAY DOSE. Valley, J. F.; Kushelevsky, A. P.; Ierch, P. (Federal Inst. of Tech., Lausanne, Switzerland). Health Phys.; 26: No. 4, 295-300(Apr 1974).

Equations to calculate the dose rate to points internal and external to spherical homogeneous β-ray sources are given. These equations are derived from a general formulation based on polynomial representation of Berger's tabulated scaled absorbed doses (J. Nucl. Med.; 12: Supplement No. 5, 5 (1971)). The dose distribution around a homogeneous spherical β ray source of radius 75 μm emitting electrons of 32.4 and 23.8 keV is calculated and compared with similar calculations by Gavron and Feige (Health Phys.; 23: 491 (1972)). (auth)

Shielding Calculations and Experiments

Refer also to abstract 28665.

28512 YADERNYE IZLUCHENIYA TEL RAZLICHNOI FORMY (OSNOVY TEORII). (Nuclear Radiation of Bodies of Different Shapes (Theoretical Bases)). Fedyushin, B. K. Leningrad; Izdatel'stvo Leningradskogo Universiteta (1973). 196p.

The bases of the macroscopic theory of the interaction of monoenergetic and polyenergetic nuclear radiation with matter were examined. The theoretical bases and calculation of the γ emission of bodies of different shapes were discussed. The theoretical bases and calculation of the capture γ emission originating in shields of different shapes under the influence of thermal electrons were examined. Some special problems of the theory and calculation of the neutron emission of symmetrical bodies were also examined. (tr-auth)

28513 ZASHCHITA OT IZLUCHENII YADERNOTEKHNICHESKIKH USTANOVOK. Tom II. (Radiation Shielding of Nuclear Installations. Volume II.). Gusev, N. G.; Kimel, L. P.; Kovalev, E. E.; Mashkovich, V. P.; Pologikh, B. G.; Suvorov, A. P. Moscow; Atomizdat (1973). 344p.

The physical–technical aspects of shielding from ionizing radiation in reactors, in plants for the reprocessing of fissionable material, in uranium mines, in accelerators, and in space vehicles are discussed. (tr-auth)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 27896, 28162, 28578, 28579, and 28936.

28514 (AD-767133-2-GA) MAGNITUDE OF AN ADIABATIC INVARIANT IN QUANTUM MECHANICS. Technical Summary Report. Wasow, W. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Jul 1973. Contract DA-31-124-ARO(D)-465. 22p. (MRC-TSR-1345). NTIS $3.25.

The adiabatic invariant of quantum mechanics for a system with finitely many states is asymptotically calculated with particular attention to its dependence on the smoothness of the Hamiltonian. (auth)

28515 (INIS-mf-1016) SYMMETRY-BREAKING HARTREE–FOCK SOLUTIONS IN A MANY-BODY SYSTEM. de Llano, M. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). Jun 1973. 8p. INIS.

Systems of N(≫1) fermions (or bosons) interacting via either repulsive long-ranged forces (e.g., Coulomb) or short-ranged forces (e.g., repulsive barrier plus attractive Yukawa tail) are clearly of interest in problems from nuclear physics to astrophysics. By comparing expectation values for determinants (or permanents) of plane-wave orbitals in the lowest kinetic-energy state, and Wannier-like orbitals localized in the points of a perfect lattice, the conditions on the coupling and particle density for the existence of energetically-preferred, spatially-periodic, nontrivial (i.e., nonplane-wave) solutions to the Hartree–Fock equations were deduced. That an electron gas in a crystalline confirmation, the "Wigner solid," has lower energy than the fluid (plane-waves) configuration at low densities (or all densities, if the charge is increased indefinitely) can be shown to imply the existence of lower-energy, spatially-periodic HF solutions. Analogously, for the short-ranged force case cited before one can show very simply that a determinant (or permanent) of non-over-lapping Wannier orbitals gives lower energy for high enough repulsive barrier in an intermediate range of densities (or all densities if the barrier height is increased indefinitely to the hard core limit) in three dimensions. Lower-energy non-trivial solutions therefore emerge under these conditions, giving a finite energy per particle even in the hard core limit. These results differ qualitatively from the one-dimensional case first studied by Overhauser and agree with those conjectured for 3-dimensions by several subsequent authors. The inclusion of attractive forces can, moreover, provide a condensed (negative energy) spatially-periodic state lower than the trivial state. One can furthermore show that there will exist a whole family of aperiodic single-determinantal states of higher (but finite) energy than the perfect hep lattice state but lower still than the trivial state. (auth)

28516 (JINR-E2-7720) TWISTED EIKONAL GRAPHS AND QUASIPOTENTIAL STRUCTURE. Kuleshov, S. P.; Matveev, V. A.; Sissakian, A. N.; Smondyrev, M. A.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 16p. Dep. NTIS (U.S. Sales Only) $4.00.

On the basis of the straight-line path method the asymptotics is studied for the twisted eikonal graphs, which violates the eikonal representation with effective Yukawa potential for the sum of ladder diagrams even in the lowest orders of perturbation theory. The results obtained are employed for reconstructing the asymptotical quasipotential. (auth)

28517 CONFIGURATION AVERAGING OF OPERATORS. Ayik, S.; Ginocchio, J. N. (Yale Univ., New Haven). Nucl. Phys.; A221: No. 2, 285-298(1974).

In order to calculate scalar averages of the product of any operators, over a finite number of many-particle states, a diagrammatic method is developed. This is generalized to the configuration averages, and it is found that configuration averages trivially follow from scalar averages. The configuration average of the product of three and four two-body operators is derived. (auth)

28518 SOLUTION OF THE SCHROEDINGER EQUATION FOR ONE CLASS OF CENTRAL-SYMMETRIC POTENTIALS. Vavrukh, M. V. (Inst. of Theoretical Physics, Lvov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 12, 2012-2021(Dec 1973). (In Russian).

Analytical solution was obtained of the equation for radial function of the particle in the central-symmetric field $(\hbar^2/ma_0^2)(\alpha/\rho)f(\rho)$ where $f(\rho)$ whole function of $\rho = a_0^{-1}|r|$ in a form of $R_l(\rho) = \rho^l e^{-\sqrt{-\epsilon}\rho} \sum_{n=0}^{\infty} C_n^l \rho^n$ with the further "convolution" of a series by n using recurrent ratios between C_n^l. The equation which roots determine a discrete spectrum of the problem levels was obtained from the condition of finiteness $R_l(\rho)$ with $\rho \to \infty$. A screened potential is considered as an example. Generalization of the suggested method is given for the case of one-dimensional problems with the complex potentials. (auth)

28519 INTEGRAL SETS AND THE SEPARATION OF VARIABLES IN THE KLEIN–GORDON EQUATION. Sukhomlin, N. B.; Shapovalov, V. N. (Kalmuck State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 122-125(1973). (In Russian).

All complete sets of integral operators of fixed form and their corresponding electromagnetic field potentials with which the Klein-Gordon equation assumes complete separation of variables were enumerated. (tr-auth)

28520 POSITIVITY OF THE φ_2^4 HAMILTONIAN. Glimm, J. (New York Univ., NY); Jaffe, A. Fortschr. Phys.; 21: No. 7, 327-376(1973).

The renormalized φ_2^4 Hamiltonian is bounded from below by a constant proportional to the volume. (auth)

28521 SEPARATION OF VARIABLES IN THE KLEIN–GORDON EQUATION. I. Bagrov, V. G.; Meshkov, A. G.; Shapovalov, V. N.; Shapovalov, A. V. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 66-72 (1973). (In Russian).

All types of external electromagnetic fields containing arbitrary functions which assume the separation of variables in the Klein-Gordon equation by means of three differential first-order symmetry operators and stationary fields assuming the separation of variables by means of two differential first-order operators and one second-order operator were found. Curvilinear coordinates in which the variables occur are reported, and equations are written in the separated variables. (tr-auth)

28522 ALGEBRAIC CLASSIFICATION OF THE MATTER TENSOR. Dozmorov, I. M. (All-Union Scientific Research Inst. of Optical-Physical Measurements, Moscow). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 101-109(1973). (In Russian).

The matter tensor constructed by use of only the energy tensor and metric tensor and all available algebraic properties of the Riemann tensor is examined. A classification, similar to the Petrov classification, is given for all types of the matter tensor. Its connection with the canonical forms of the corresponding energy tensors is given. (tr-auth)

28523 BROKEN SYMMETRY IN RESTRICTED GEOMETRIES. Garrison, J. C. (Univ. of California, Livermore); Wong, J.; Morrison, H. L. Lect. Theor. Phys.; 14B: 133-145(1973).

The application of C* algebra techniques to the problem of broken symmetry and long-range order in systems with restricted geometries is discussed. Thin-film systems, that is, physical systems that are constrained to lie between two infinitely extended parallel planes with separation L are considered. Thin-film superfluid helium and thin-film superconductors are mentioned. (JFP)

28524 DEFINITION OF POSITION AND SPIN OPERATORS FOR MASSIVE ELEMENTARY RELATIVISTIC SYSTEMS OF ARBITRARY SPIN. de Azcárraga, J.A. (Departamento de Física Teórica and GIFT, Facultad de Ciencias, Diagonal s/n Barcelona-14, Spain); Pascual, J. Phys. Rev. D 8: No. 12, 4375-4382 (15 Dec 1973).

Since the important work of Newton and Wigner on the position operator and the localized states, several methods have been developed in the literature to deal with the problem of finding a position operator for relativistic systems. One of the most relevant has been the method based on the use of "canonical" transformations such as the Foldy–Wouthuysen transformation. In this paper, we strictly consider the Foldy–Wouthuysen transformation as a procedure which allows one to write the Bargmann–Wigner equations in a form which in the nonrelativistic limit leads to the Galilei-invariant Schrödinger equations for arbitrary spin. As a result of this interpretation, we derive for position operator and the localized states of elementary systems the same expressions as Newton and Wigner; the spin operator is also obtained. Finally, the Chakrabarti transformation is considered in the same spirit. (auth)

28525 EXPANSION OF THE UNBOUND SOLUTION OF THE SCHROEDINGER EQUATION MULTIPLIED BY A GAUSS ONE IN TERMS OF HARMONIC OSCILLATOR WAVE FUNCTIONS. Cirstoiu, B. (Inst. of Atomic Physics, Bucharest); Deberth, C.; Hategan, C.; Sandulescu, A. Rev. Roum. Phys.; 18: No. 10, 1239-1248(1973).

Analytical expressions for the expansion coefficients of the unbound solution of the Schrödinger equation in terms of har-

monic oscillator wave functions multiplied by a Gauss one are given. Numerical convergence of the expansion coefficients for the cases of plane and coulomb waves is studied. (auth)

28526 INTRODUCTION TO THE THEORY OF GROUPS AND GROUP REPRESENTATIONS. I. Stroem, S. (Inst. of Theoretical Physics, Goteborg). Fields Quanta; No. 3, 263-344(1973).

A survey lecture is given of the general results required for the understanding of the theory of the unitary irreducible representations of the Lorentz and Poincare groups as they are used in present day theoretical physics. The generality of the methods usually used for the Lorentz and Poincare groups is emphasized. (JFP)

28527 EXTRA SELECTION RULES. Backhouse, N. B. (Univ. of Liverpool). J. Math. Phys. (N. Y.); 15: No. 1, 119-124(Jan 1974).

The recognition of antiunitary symmetry in a quantum mechanical system is considered in relation to selection rules. It is shown that the interaction of unitary symmetry and the antiinvariance of matrix elements under antiunitary operators can produce extra selection rules in magnetic systems. The criteria obtained for the occurrence of these additional selection rules are presented in the form of group character tests, and in a special case provide an application for the symmetrized and antisymmetrized squares of group representations. (auth)

28528 LOGICAL ANALYSIS OF QUANTUM MECHANICS. Scheibe, E. International Series of Monographs in Natural Philosophy. Volume 56. New York; Pergamon Press (1973). 210p.

Translated by J. B. Sykes.

The discussion covers Bohr's interpretation of quantum mechanics, formulation in terms of quantities and in terms of properties for orthodox quantum mechanics in Hilbert space, determinism and indeterminism, attempts at an axiomatic foundation of orthodox quantum mechanics (the Von Neumann program), reduction of states and the measurement process, and completeness and reality. (JFP)

28529 RAYLEIGH-RITZ METHOD, SECULAR DETERMINANT, AND ANHARMONIC OSCILLATORS. Graffi, S.; Grecchi, V. (Istituto Nazionale di Fisica Nucleare, Bologna). Phys. Rev., D; 8: No. 10, 3487-3492(15 Nov 1973).

The standard Rayleigh-Ritz procedure yielding the successive truncations of the secular determinant is applied to any anharmonic oscillator (x^{2m} and in any finite number of dimensions). In this way one obtains a rigorously convergent as well as numerically very effective approximation procedure for any eigenvalue and eigenvector of the above mentioned Hamiltonians. (auth)

28530 PERTURBATION OF THE NONSELFAJOINT ONE-DIMENSIONAL SCHROEDINGER OPERATOR. Alenitsyn, A. G. Vestn. Leningrad. Univ., Mat., Mekh., Astron.; No. 3, 160-161 (Jul 1973). (In Russian).

The results obtained previously are generalized for the case of a complex-valued potential, the values of this potential are outside of a parabolic curve. (auth)

28531 CONFORMAL MOMENTUM. Chernikov, N. A.; Shavokhina, N. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 18: No. 3, 310-317(Mar 1974). (In Russian).

The conformal momentum is studied. A theorem on the energy-momentum tensor of the scalar and spinor fields is proved. (auth)

28532 THEORETICAL GROUP ANALYSIS OF THE COHERENT PROPERTIES OF SOME PHYSICAL SYSTEMS (SPONTANEOUS RADIATION, MODULATED BEAMS). Makhviladze, T. M.; Shelepin, L. A. Tr. Fiz. Inst., Akad. Nauk SSSR; 70: 120-146 (1973). (In Russian).

The theoretical group approach is applied to the study of collective properties of concrete multiparticle systems. The Dicke theory of coherent spontaneous radiation is generalized to the case of multilevel emitters. The effects of superradiation and photon echoes in multilevel systems are investigated. Two generalizations of the coherent state of oscillators are examined: 1) coherent states of unitary spin obeying the classical limitations in the Dicke problem and 2) coherent states for systems with non-equidistant spectra (using an example of a rotating body). A description is given of the coherent properties of beams of particles of different nature. It is shown that the correlation between particles of the incident beam can lead to significant increase of the probability of their interaction with the scatterer. (tr-auth)

28533 DEVELOPMENT OF THE ANALOGY BETWEEN CLASSICAL AND QUANTUM MECHANICS. Mukunda, N. (Indian Inst. of Science, Bangalore). Pramana; 2: No. 1, 1-14(Jan 1974).

A quantum-mechanical generalization of Caratheodory's theorem in classical dynamics is established. Several related properties of classical canonical transformations are also generalized to the quantum case. (auth)

28534 COMMENTS ON GENERALIZED HAMILTONIAN DYNAMICS. Estabrook, F. B. (California Inst. of Tech., Pasadena). Phys. Rev., D; 8: No. 8, 2740-2743(15 Oct 1973).

A reasonable generalization of Hamiltonian theory to 3m-dimensional phase space suggests a geometrical structure giving the proper characteristic vector field. This structure, however, has only a single integral invariant, and implies no sensible generalization of either Poisson-bracket formalism, or Hamilton-Jacobi theory. Associated statistical mechanics and quantization are unlikely. The algebraic source of the difficulty is the lack of understanding of canonical expressions and classes of closed 3-forms. (auth)

28535 KINETIC EQUATIONS FOR THE QUANTIZED MOTION OF A PARTICLE IN A RANDOMLY PERTURBED POTENTIAL FIELD. Besieris, I. M. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Tappert, F. D. J. Math. Phys. (N.Y.); 14: No. 12, 1829-1836(Dec 1973).

Within the framework of the first-order smoothing approximation and the long-time, Markovian approximation, kinetic equations are derived for the stochastic Wigner equation (the exact equation of evolution of the phase-space Wigner distribution function) and the stochastic Liouville equation (correspondence limit approximation) associated with the quantized motion of a particle described by a stochastic Schrödinger equation. In the limit of weak fluctuations and long times, the transport equation for the average probability density of the particle in momentum space which was reported recently by Papanicolaou is recovered. Also, on the basis of the Novikov functional formalism, it is established that several of the approximate kinetic equations derived are identical to the exact statistical equations in the special case that the potential field is a δ-correlated (in time), homogeneous, wide-sense stationary, Gaussian process. (auth)

28536 DUFFIN-KEMMER-PETIAU SUBALGEBRAS: REPRESENTATIONS AND APPLICATIONS. Fischbach, E. (Purdue Univ., Lafayette, IN); Nieto, M. M.; Scott, C. K. J. Math. Phys. (N.Y.); 14: No. 12, 1760-1774(Dec 1973).

A reduction of the Duffin-Kemmer-Petiau algebra to a direct sum of irreducible subalgebras for spin-0 and spin-1 bosons is presented. The subalgebras are defined by multiplication rules for the linearly independent basis elements. In the representations discussed the spin projection operators are independent basis elements of the subalgebras. The formal utility of these representations is demonstrated by obtaining the reduction of arbitrary operator products and trace theorems. The practical utility is demonstrated by application to the analysis of free and interacting boson field currents. Most importantly, one can understand the differences between DKP nonconserved currents and those obtained from second-order wave equations. (auth)

28537 SPINOR REPRESENTATIONS OF THE ORTHOGONAL GROUPS. Lohe, M. A. (Univ. of Adelaide). J. Math. Phys. (N.Y.); 14: No. 12, 1959-1964(Dec 1973).

It is shown how to construct all spinor representations of O(n). For the low order groups, this is done in such a way as to obtain the representation space of the covering group. More generally all representations of O(n) are constructed in spaces of harmonic homogeneous polynomials. This is achieved for the spinor representations by finding realizations of the Lie algebra of O(n) which are new. Results are written out explicitly for O(3). (auth)

28538 QUANTIZATION OF A GENERAL DYNAMICAL SYSTEM. Ben-Abraham, S. I.; Lonke, A. (Univ. of Negev, Beer-Sheva, Israel). J. Math. Phys. (N.Y.); 14: No. 12, 1935-1937 (Dec 1973).

Invariance implies that the momentum operator should be represented by the covariant derivative. For a general dynamical system, both covariant canonical and path integral quantization yield in the Schrödinger equation a correction term proportional to the curvature. Earlier erroneous calculations are hereby corrected and reconciled. (auth)

28539 WIGNER AND RACAH COEFFICIENTS FOR SU_3. Draayer, J. P.; Akiyama, Y. (Univ. of Michigan, Ann Arbor). J. Math. Phys. (N.Y.); 14: No. 12, 1904-1912(Dec 1973).

A general yet simple and hence practical algorithm for calculating $SU_3 \supset SU_2 \times U_1$ Wigner coefficients is formulated. The resolution of the outer multiplicity follows the prescription given by Biedenharn and Louck. It is shown that SU_3 Racah coefficients can be obtained as a solution to a set of simultaneous equations with unknown coefficients given as a by-product of the initial steps in the $SU_3 \supset SU_2 \times U_1$ Wigner coefficient construction algorithm.

A general expression for evaluating $SU_3 \supset R_3$ Wigner coefficients as a sum over a simple subset of the corresponding $SU_3 \supset SU_2 \times U_1$ Wigner coefficients is also presented. State conjugation properties are discussed, and symmetry relations for both the $SU_3 \supset SU_2 \times U_1$ and $SU_3 \supset R_3$ Wigner coefficients are given. Machine codes based on the results are available. (auth)

28540 SYMMETRY MAPPINGS OF CONSTRAINED DYNAMICAL SYSTEMS AND AN ASSOCIATED RELATED INTEGRAL THEOREM. Levine, J.; Katzin, G. H. (North Carolina State Univ., Raleigh). J. Math. Phys. (N.Y.); 14: No. 12, 1886-1891 (Dec 1973).

By use of Lie derivatives symmetry mappings of constrained conservative dynamical systems are formulated in terms of continuous groups of infinitesimal transformations within the configuration space. Such symmetries are called "natural trajectory collineations" in that the total energy has the same fixed value along each trajectory of the natural family, this value being preserved by the symmetry. It is found that these natural trajectory collineations must be conformal motions subject to an additional restriction dependent upon the potential. The corresponding groups of natural trajectory collineations are obtained for a flat configuration space with potential energy functions with rotational invariance about a point. A specialization of the theory to an indefinite Riemannian space-time shows that homothetic transformations are necessary and sufficient to map a natural family of time (space)-like geodesics into itself. A related integral theorem for constrained dynamical systems admitting linear or quadratic constants of the motion is obtained and illustrated. This theorem shows that in general a new constant of the motion will be obtained by deformation of an existing constant of the motion under a natural trajectory collineation. (auth)

28541 PERTURBATION OF THE SPECTRUM OF THREE-DIMENSIONAL HARMONIC OSCILLATOR BY A DELTA-POTENTIAL. Janev, R. K. (Observatoire de Paris, Meudon, France); Maric, Z. Phys. Lett.; 46A: No. 5, 313-314(14 Jan 1974).

The perturbed spectrum of a three-dimensional harmonic oscillator by a δ-potential is determined at large separations between the potential centers. Two groups of levels are found with quite different behavior. (auth)

28542 ERGODIC FEATURES OF HARMONIC-OSCILLATOR SYSTEMS. I. Titulaer, U. M. (State Univ., Utrecht). Physica; 70: No. 2, 257-275(1 Dec 1973).

Systems of harmonic oscillators are often used as models to describe the approach to equilibrium of certain physical quantities in real systems. Obviously the development in time of certain suitably chosen operators shows ergodic features in spite of the fact that harmonic systems as a whole are highly nonergodic. To obtain a better understanding of such phenomena the time development of phase functions in general finite harmonic systems, and the rules according to which "ergodic phase functions" can be selected are discussed. As an illustration the behavior of several physical quantities for an anisotropic oscillator in a magnetic field is discussed. (auth)

28543 ERGODIC FEATURES OF HARMONIC-OSCILLATOR SYSTEMS. II. Asymptotic Ergodicity. Titulaer, U. M. (State Univ., Utrecht). Physica; 70: No. 2, 276-296(1 Dec 1973).

The study, started in an earlier paper, of the ways in which certain quantities in harmonic-oscillator systems may show ergodic behavior is continued. In particular the ergodic features that emerge when the system under consideration becomes large are discussed. For some nonergodic phase functions the deviation from ergodic behavior goes to zero in this limit. It is proposed to call those phase functions asymptotically ergodic. In a regular harmonic lattice all local phase functions turn out to be asymptotically ergodic, provided the frequency spectrum shows a gap around zero. When arbitrarily low frequencies do occur one must impose some additional condition in order to exclude local functions that exhibit very large fluctuations. (auth)

28544 PERTURBATIONAL CALCULATION RELATIVE TO THE ENERGY STATES OF THE LINEAR HARMONIC OSCILLATOR IN THE PATH-INTEGRAL FORMALISM OF NONRELATIVISTIC QUANTUM MECHANICS. Grosjean, C. C. (Univ., Ghent); Goovaerts, M. J. Physica; 70: No. 2, 243-256(1 Dec 1973).

Starting from the path-integral expression for the density matrix associated with the quantized linear harmonic oscillator, a perturbational series expansion with respect to the potential part is carried out. Using various mathematical artifices, an explicit infinite series is obtained for the integral of the density matrix with respect to the endpoint coordinate. The correctness of the obtained expansion is verified by summation and comparison of the result with the known formula in closed form. (auth)

28545 ORBITAL THEORIES IN THE SPIN-CORRELATION PROBLEMS. II. Unrestricted and Spin-Extended Hartree-Fock Theories. Nakatsuji, H. (Kyoto Univ.). J. Chem. Phys.; 59: No. 5, 2586-2595(1 Sep 1973).

A perturbation-variation treatment is applied to interconnect the unrestricted, projected unrestricted, and spin-extended Hartree-Fock wave functions with the first order sum-over-state perturbation wave function. The restricted Hartree-Fock wave function is chosen as a starting point. From these, the interrelations among these theories are clarified not only for the first order correction to the wave functions but also for their spin densities. Moreover, the natures of the unrestricted and spin-extended Hartree-Fock theories in the spin-correlation problems are examined in the light of the physical reality of the correlation phenomens in open-shell electronic systems. These results are ascertained numerically by referring the spin densities calculated by these various methods and obtained from experiments. (auth)

28546 SURVEY OF HIDDEN-VARIABLES THEORIES. Belinfante, F. J. International Series of Monographs in Natural Philosophy. Volume 55. New York; Pergamon Press Ltd. (1973). 355p.

The review covers three kinds of hidden-variable theories and so-called proofs of impossibility and theories of the first and second kind. (JFP)

28547 SPIN-FREE WAVE FUNCTIONS IN MANY-ELECTRON PERTURBATION THEORY. I. Closed-Shell Systems. Shibuya, T. I.; Sinanoglu, O. (Yale Univ., New Haven). Int. J. Quant. Chem.; 7: No. 6, 1145-1158(Nov 1973).

The Schrödinger equation of an N-electron closed-shell system is reduced to that for the spatial wave function Ψ by the aid of the theory of the symmetric (permutation group S_N). The first-order perturbation equation based on the Hartree-Fock-scf model as the zero-order solution is then solved by decomposing it into a set of soluble $\frac{1}{2}(N/2)[(N/2)+1]$ equations for the pair-correlation (first-order) spatial wave functions. These spatial functions give the spatial parts of the pair functions in the spin orbital basis formulation, reducing also the number of independent pairs needed in the first order. (auth)

Quantum Field Theories

Refer also to abstracts 27752, 27858, 27875, 27891, 28076, 28597, 28604, 28619, and 28621.

28548 (DESY-73-53) HIGHER ORDER PERTURBATION THEORY OF EXPONENTIAL LAGRANGIANS: FOURTH ORDER. Pohlmeyer, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Nov 1973. 34p. Dep. NTIS (U.S. Sales Only) $3.75.

The vacuum expectation value of the time-ordered product of four exponentials of free massless scalar fields is defined as a continuous linear functional over a suitable test function space using minimal singularity as a criterion. (auth)

28549 (DESY-73-58) MASSLESS ϕ^4 THEORY IN 4-ϵ DIMENSIONS. Symanzik, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Dec 1973. 46p. Dep. NTIS (U. S. Sales Only) $4.50.

The Green's functions of massless ϕ^4 theory in 4-ϵ dimensions are in perturbation theory infrared singular at certain positive rational ϵ. By analyzing the small-mass behavior of the massive-theory functions and performing the limit to zero mass with care, one obtains terms nonanalytic in the coupling constant in addition to the usual perturbation theoretical ones. In this new expansion, the infrared singularities cancel out. This phenomenon is related to the nonvanishing of the bare mass in the zero-physical-mass theory. (auth)

28550 (JINR-P2-7719) DERIVATION OF EQUATION OF QUASIPOTENTIAL TYPE USING THE METHOD OF FOCK-PODOLSKY. Blokhintsev, D. I.; Rizov, V. A.; Todorov, I. T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 28p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.50.

A quasipotential equation is derived for the relativistic Coulomb problem from the equations of motion of quantum electrodynamics using the method of Fock-Podolsky (Tamm-Dancoff). Relation with an inhomogeneous equation for the 4-point retarded function is exhibited. (auth)

28551 (SLAC-167(Vol.2), pp 141-153) TESTS OF QUANTUM ELECTRODYNAMICS AND LIMITS ON WEAK AND STRONG INTERACTIONS. Brodsky, S. J. (Stanford Linear Accelerator Center, CA). Nov 1973.

In Proceedings of Summer Institute on Particle Physics, July 9–28, 1973. Volume II.

The discussion covers hadronic vacuum polarization and quantum electrodynamics colliding beam tests, precision tests of quantum electrodynamics, and colliding beam tests of the weak interactions and gauge theories. (JFP)

28552 (SLAC-167(Vol.2), pp 251-263) SCALING IN QUANTUM FIELD THEORY. Gross, D. J. (Princeton Univ., NJ). Nov 1973. In Proceedings of Summer Institute on Particle Physics, July 9–28, 1973. Volume II.

Recent work on the application of renormalization group techniques to the problem of Bjorken scaling in quantum field is reviewed. The framework used is ordinary renormalizable quantum field theory. The renormalization group of Gell–Mann and Low is used, and it is assumed that Bjorken scaling is an asymptotic phenomenon. (JFP)

28553 CONSTRUCTION OF A FINITE ENERGY MOMENTUM TENSOR. Clark, T. E. (New York Univ., NY). Nucl. Phys.; B70: No. 3, 425-436(1974).

A non-perturbative approach, postulating the existence of a family of Zimmermann normal products, certain linear relations among field operators, and the Wilson short distance expansion, is used to construct a finite energy momentum tensor. The dependence of the tensor on the field operators is made explicit by a suitable limit procedure. The calculations are performed in a scalar A^4 model as an example. The results obtained are generalizations of the perturbation theory treatment of products of operators. (auth)

28554 MINIMAL COUPLING IN SPIN-2 FIELD. Reilly, J. F. (Univ. of Southampton, Eng.). Nucl. Phys.; B70: No. 2, 356-364(1974).

It is shown that the spin-2 Lagrangian of Watanabe and Bhargava can be generalized by the introduction of a real parameter b associated with derivative ordering. After minimal coupling the spin-2 dynamical equations of Nath and Velo and Zwanziger can be derived as special cases. The constraint situation in these equations is then summarized and related to the first-order Lagrangian approach of Federbush, Chang, et al. Only one value of the parameter b gives a correct manifold of states after coupling. Finally it is shown that the auxiliary field approach to spin-2 proposed by Chang is dynamically inconsistent under minimal coupling. (auth)

28555 CONFORMAL COVARIANCE OF THE MAXWELL EQUATIONS. Mavrychev, Yu. S. (Ivanova Energy Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 139-141(1973). (In Russian).

It was shown that with respect to the 15-parametric conformal transform the Lorentz condition is noncovariant. (JSR)

28556 INVERSE EXTINCTION THEOREMS IN ELECTRODYNAMICS. de Goede, J. (Rijksuniversiteit, Leiden). Physica; 70: No. 1, 125-134(15 Nov 1973).

Inverse extinction theorems in electrodynamics are derived from the conventional linear response theory for a material system to an external electromagnetic field. Such inverse extinction theorems can also be obtained directly from the phenomenological Maxwell theory. (auth)

28557 QUANTUM ELECTRODYNAMICS AND RENORMALIZATION THEORY IN THE INFINITE-MOMENTUM FRAME. Brodsky, S.J. (Stanford Linear Accelerator Center, Stanford, California 94305); Roskies, R.; Suaya, R. Phys. Rev. D 8: No. 12, 4574-4594 (15 Dec 1973).

Time-ordered perturbation theory evaluated in the infinite-momentum reference frame of Weinberg is shown to be a viable calculational alternative to the usual Feynman graph procedure for quantum electrodynamics. We derive the rules of calculation at infinite momentum, and introduce a convenient method for automatically including z graphs (backward moving fermion contributions). We then develop techniques for implementing renormalization theory, and apply these to various examples. We show that the $P \to \infty$ limit is uniform for calculating renormalized amplitudes, but this is not true in evaluating the renormalization constants themselves. Our rules are then applied to calculate the electron anomalous moment through fourth order and a representative diagram in sixth order. It is shown that our techniques are competitive with the normal Feynman approach in practical calculations. Some implications of our results and connections with the light-cone quantization are discussed. (auth)

28558 IMPROVED TREATMENT FOR THE INFRARED-DIVERGENCE PROBLEM IN QUANTUM ELECTRODYNAMICS. Grammer, G. Jr.; Yennie, D.R. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850). Phys. Rev. D 8: No. 12, 4332-4344 (15 Dec 1973).

Although the conceptual difficulties associated with infrared divergences in quantum electrodynamics have long since been resolved, a convenient technique for identifying the appropriate infrared-finite part of Feynman graphs has been lacking. Such a technique is presented here. The polarization sums for both real and virtual photons are rearranged into two parts. One of these (called the K-polarization sum) resembles a gauge transformation whose structure permits a simple demonstration of infrared factorization and exponentiation. It is easy to see by inspection that the residual factors (with G-polarization sums) are infrared free. This is done for each separate graph, in contrast to earlier treatments where contributions from sets of graphs had to be considered together. The technique is illustrated by a detailed treatment of the radiative corrections to lowest-order potential scattering and generalizations to other processes are indicated. (auth)

28559 REMARKS ON MASSIVE SPIN-ONE PARTICLES. Kyriakopoulos, E. (Nuclear Research Center "Democritos" Aghia Paraskevi Attikis, Athens, Greece). Phys. Rev. D 8: No. 12, 4345-4346 (15 Dec 1973).

The construction of a Lagrangian such that its isospin current is the source of the vector-meson field, when the vector mesons are described by a tensor field, is studied. The physical significance of the contact terms of the tensor description, as far as the s-wave scattering lengths is concerned, is discussed. (auth)

28560 EQUILIBRIUM STATES IN STATISTICAL MECHANICS C*-ALGEBRAIC APPROACH. Hugenholtz, N. M. (Univ., Groningen, Netherlands). Lect. Theor. Phys.; 14B: 281-308 (1973).

Infinite systems, particularly infinite quantum systems are considered. It is pointed out that algebraic methods can be applied not only to statistical mechanics but also to quantum field theory. Inequivalent representations of canonical anticommutation relations, states and observables, observable algebras for certain simple cases, the ground state, the equilibrium state at T and O, the Heisenberg model with long-range interaction are covered. (JFP)

28561 FUNCTIONAL TECHNIQUES AND THEIR APPLICATION IN QUANTUM FIELD THEORY. Klauder, J. R. (Bell Telephone Labs., Inc., Murrary Hill, NJ). Lect. Theor. Phys.; 14B: 329-421(1973).

Probability theory and Hilbert space methods for the analysis of certain classes of models in field theory are reviewed and developed, covering the ultralocal and scalar field theories, scale invariant models, and the scale dimension of the fields. (JFP)

28562 BJORKEN SCALING IN QUANTUM FIELD THEORY. Callan, C.G. Jr.; Gross, D.J. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 8: No. 12, 4383-4394 (15 Dec 1973).

We discuss the conditions under which renormalization-group methods can imply Bjorken scaling for deep-inelastic structure functions. We prove and refine a conjecture of Parisi's concerning the high-spin behavior of anomalous dimensions in order to show that in most theories Bjorken scaling is possible only if the renormalization group has a fixed point at the origin of coupling-constant space. (auth)

28563 ASYMPTOTIC SCALE INVARIANCE IN A MASSIVE THIRRING MODEL WITH U(n) SYMMETRY. Mitter, P.K.; Weisz, P.H. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 8: No. 12, 4410-4429 (15 Dec 1973).

Renormalized Ward identities and Callan-Symanzik equations are developed for vertex functions involving composite fields in a massive Thirring model with U(n) symmetry. The existence of a critical curve of fixed points of a renormalization group acting on a space of coupling constants is proved. On this curve all nonsoft axial-vector and scaling anomalies vanish. Attraction properties of this curve are investigated. The possibility of a second critical curve for strong coupling is discussed. (auth)

28564 DERIVATION OF GENERAL CONSERVATION LAWS AND WARD-TAKAHASHI IDENTITIES IN THE FUNCTIONAL INTEGRATION METHOD. Suura, H. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455); Young, B. Phys. Rev. D 8: No. 12, 4353-4371 (15 Dec 1973).

The functional integration method is applied to derive Ward-Takahashi identities involving the energy-momentum tensor, currents, and fields. In the process of the derivation, we have introduced a variational method to derive conservation laws, in which the improved energy-momentum tensor of Callan, Coleman, and Jackiw is obtained. Establishing the correspondence between the c-number relations obtained in the functional integration method and the q-number ones resulting from the conventional way, we demonstrated that the two approaches of quantum field theory give identical results for the perturbation expansion, canonical equal-time commutation relations, etc. They are, therefore, equivalent. (auth)

28565 RENORMALIZABILITY OF GAUGE THEORIES WITH SPONTANEOUSLY BROKEN DISCRETE SYMMETRIES. Lee, S.Y.; Rawls, J.M.; Yu, L. (Department of Physics, University of California, San Diego, La Jolla, California 92037). Phys. Rev. D 8: No. 12, 4479-4481 (15 Dec 1973).

It is shown that a large class of global symmetries, including the

physically interesting discrete symmetries, may be broken spontaneously in gauge theories without destroying renormalizability. (auth)

28566 REGGEIZATION OF ELEMENTARY PARTICLES IN RENORMALIZABLE GAUGE THEORIES: VECTORS AND SPINORS. Grisaru, M.T.; Schnitzer, H.J.; Tsao, H. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. D 8: No. 12, 4498-4509 (15 Dec 1973).

The question of the Reggeization of the elementary particles in renormalizable gauge theories with the Higgs–Kibble mechanism is examined. It is concluded that the massive non-Abelian gauge vector mesons and $J = 1/2$ fermions of these theories lie on Regge trajectories in every case in which a counting criterion due to Mandelstam is satisfied. Several explicit examples are presented which verify that the necessary factorization condition of the Born helicity matrices is satisfied at $J = 1$ and $J = 1/2$, supporting this conclusion. (auth)

28567 A FIELD-THEORY FORMULATION OF THE PARTON MODEL. Sanda, A.I. (National Accelerator Laboratory, P. O. Box 500, Batavia, Illinois 60510). Phys. Rev. D 8: No. 12, 4510-4524 (15 Dec 1973).

A formulation of field theory given by Van Hove in 1955 is shown to be useful for putting "parton-model-like ideas" on firm theoretical grounds. This is done by discussing electron–proton deep-inelastic scattering, electron–positron annihilation, and the proton elastic form factor. A basic requirement that must be imposed on any field theory in order to discuss the concept of hadronic constituents is given. To put the formulation on a firm ground (with respect to renormalizability), we assume that the wave-function renormalization constants of the theory are finite. This assumption satisfies the above-mentioned basic requirements, though it probably is not necessary. Within this framework we prove that $\nu W_2(q^2, \nu)$ is the same as that derived in the parton model. In this formalism, electron–positron annihilation is quite different in character from deep-inelastic electron–proton scattering. The constancy of the ratio σ (e^+e^- hadrons)/σ ($e^+e^-\mu^+\mu^-$) can be derived only if much stronger assumptions than the one mentioned above are adopted.The price paid for simplicity in the renormalization procedure is two physically undesirable results: (a) The proton elastic form factor is probably finite at large momentum transfer, and (b) νW_2 is finite and nonzero at $x=1$. It is conjectured that these problems can be solved without changing other results by allowing wave-function renormalization constants to become infinite. (auth)

28568 VERTEX FUNCTIONS AND GREEN FUNCTION IN $4-\epsilon$ DIMENSIONAL PHASE TRANSITION THEORY. Ginzburg, S. L. (Leningrad Inst. of Nuclear Physics). Zh. Eksp. Teor. Fiz.; 66: No. 2, 647-654(Feb 1974). (In Russian).

The vertex functions, polarization operator and Green function in $4-\epsilon$ dimensional theory of phase transitions with a φ^4 interaction are determined for small values of ϵ by direct summation of perturbation theory diagrams. The expressions obtained are valid in the range of applicability of perturbation theory as well as in the scaling region. (auth)

28569 LOW-ENERGY THEOREMS IN THE S-MATRIX ELECTRODYNAMICS. Pron'ko, G. P. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 18: No. 2, 203-211(Feb 1974). (In Russian).

In the framework of the S-matrix electrodynamics all the model-independent terms in the expansion of the bremsstrahlung matrix element over the photon energy are found. Similar expressions are obtained for processes including a charged virtual particle. Using the expansions obtained for the bremsstrahlung matrix element, it is shown that the Low and Gell-Mann–Goldberger threshold theorem for Compton scattering on a zero spin charged particle is valid in all orders with respect to electromagnetic interaction. (auth)

28570 MASSIVE VECTOR FIELD AS A SOURCE OF THE SPACE–TIME TORSION. Rochev, V. E. (Inst. of High Energy Physics, Serphkhov, USSR). Teor. Mat. Fiz.; 18: No. 2, 226-232(Feb 1974). (In Russian).

It is shown that the gravitational interaction of a massive vector field in the Lagrangian formalism can be characterized by means of an asymmetrical connectivity with torsion proportional to spin density. (auth)

28571 METHOD OF SUMMING THE PERTURBATION THEORY SERIES IN SCALAR THEORY. Basuev, A. G.; Vasil'ev, A. N. (Leningrad State Univ.). Teor. Mat. Fiz.; 18: No. 2, 181-189 (Feb 1974). (In Russian).

For the example of the connected vacuum loops in the $-\lambda\varphi^4$ theory, the method of summing the perturbation theory series is considered, in which the number of graphs is taken into account exactly, while the deviation of the mean value of the graph from the pure power law is modelled by means of the change $\lambda \to \lambda e^{it}$ and the subsequent averaging over t with some weight function f(t) (the function f remains indetermined). The expression obtained is analytic in a certain sector including the semi-axis $\lambda > 0$. At $\lambda = 0$ there is an essential singularity generated by concentric cuts, which converge to the point $\lambda = 0$ and are not included in the analyticity region. (auth)

28572 EXPERIMENTAL SEARCH FOR ANISOTROPY IN THE SPEED OF LIGHT. Trimmer, W. S. N.; Baierlein, R. F.; Faller, J. E.; Hill, H. A. (Wesleyan Univ., Middletown, CT). Phys. Rev., D; 8: No. 10, 3321-3326(15 Nov 1973).

A triangular interferometer passes two beams around the interferometer in opposite directions. A portion of the optical path contains a piece of glass. If the phase velocity of light is anisotropic, the fringe pattern will shift as the interferometer is rotated relative to the fixed stars. The interferometer is sensitive to anisotropies that behave as the first or third Legendre polynomials, $P_1(\cos\phi)$ and $P_3(\cos\phi)$, where ϕ is the angle between a preferred direction in space and the direction of light propagation. The maximum change in the speed of light is less than 0.03 ± 2.5 cm/sec for the P_1 anistropy, and is less than 0.7 ± 0.45 cm/sec for the P_3 anisotropy. If an ether wind can be described by a Fresnel dragging coefficient when light passes through glass, the ether wind would be detectable by this experiment. This experiment sets an upper limit of 0.045 ± 3.8 cm/sec for the ether wind at the surface of the earth. This is about one-millionth of the earth's orbital velocity. (auth)

28573 ANISOTROPIC MODIFICATION OF MAXWELL'S EQUATIONS. Trimmer, W. S. N.; Baierlein, R. F. (Wesleyan Univ., Middletown, CT). Phys. Rev., D; 8: No. 10, 3326-3328 (15 Nov 1973).

A modified form of Maxwell's equations, one designed to produce anisotropic light propagation in a vacuum is examined. The equations predict anisotropies in the speed of light that behave as $\cos\phi$ and $\cos2\phi$, where ϕ is the angle between the actual direction of propagation and some single preferred direction in space. The predicted index of refraction also has terms that behave as $\cos\phi$ and $\cos2\phi$. (auth)

28574 MATRIX ELEMENTS OF THE QUANTUM ELECTRODYNAMICS. Fedorov, F. I. (Inst. of Physics, Minsk). Teor. Mat. Fiz.; 18: No. 3, 329-338(Mar 1974). (In Russian).

Recursion relations are obtained which lead to simple and compact expressions for the traces of operators including a large number of the Dirac matrices. It is shown that in the case of moving particle the spin projection on arbitrary direction may possess a determined value. The general relation for calculating the matrix elements (and not their squared moduli) is given, which simplifies greatly the calculations of cross sections for different processes in the quantum electrodynamics, especially when polarizations of all particles are taken into account. (auth)

28575 ELECTROMAGNETIC FIELD IN THE GAUGE SU(3) × SU(3) CHIRAL GROUP. Hosek, J. (Inst. of Nuclear Physics, Rez, Czech.). Nucl. Phys.; B70: No. 1, 133-140(1974).

The massless electromagnetic Yang-Mills field is explicitly constructed as a linear combination $E\mathcal{V}_\mu + (1/\sqrt{3})\, E\mathcal{V}'_\mu$ of 16 gauge fields of the chiral SU(3) × SU(3) group within the framework of the plasmon generating mechanism. The remaining 15 gauge fields acquire a mass through the nonzero vacuum expectation values of the auxiliary scalar multiplet which transforms according to the (8,8) representation of the gauge group. The tadpoles with nonzero hypercharge which are required for the existence of the only massless electromagnetic potential A_μ are due to the natural mixing of charged weak currents with $\Delta S = 0$ and $\Delta S = 1$. The relevance of this phenomenon to the Cabibbo angle is briefly discussed. Also presented is a theorem concerning an admissible form of the zero-order mass term of gauge fields when the canonical number is unknown. (auth)

28576 SUPERGAUGE TRANSFORMATIONS IN FOUR DIMENSIONS. Wess, J. (Univ., Karlsruhe, Ger.); Zumino, B. Nucl. Phys.; B70: No. 1, 39-50(1974).

Supergauge transformations are defined in four space-time dimensions. Their commutators are shown to generate γ_5 transformations and conformal transformations. Various kinds of multiplets are described and examples of their combinations to new representations are given. The relevance of supergauge transformations for Lagrangian field theory is explained. Finally, the abstract group theoretic structure is discussed. (auth)

28577 COMBINATORICS AND RENORMALIZATION IN QUANTUM FIELD THEORY. Caianiello, E. R. Frontiers in Physics. Reading, MA; W. A. Benjamin, Inc. (1973). 136p. $16.00.

The topics discussed are combinatoric methods, equations for propagators and perturbative expansions, regularization, renormalization, and mass equations. (JFP)

28578 QUANTIZATION OF THE SPACE–TIME COORDINATES AND THE RESULTING DEGREES OF FREEDOM. Meessen, A. (Univ., Louvain, Belgium). Ann. Soc. Sci. Brux. Ser. I; 88: No. 1, 71-85(1974).

The space-time coordinates x, y, z, ct can be quantized in such a way that each one of them is an integer or a half-integer multiple of the same quantum of length a. This implies the existence of sixteen possible space-time lattices of lattice constant a, for every arbitrarily chosen inertial reference frame. Electromagnetic fields and scaler field can be defined on a single space-time lattice of lattice constant a, but the generalization of the Dirac equation requires a coupling of different four-component spinors, which are defined on different space-time lattices. The previously given representation, which coupled only two four-component spinors, is replaced by a representation that couples the sixteen possible four-component spinors, in agreement with the proposed quantization scheme for the space-time coordinates. (auth)

28579 EMBEDDING OF UNSTABLE NON-RELATIVISTIC PARTICLES INTO GALILEAN QUANTUM FIELD THEORIES. Lunz, L.; Lugiato, L. A.; Ramella, G.; Sabbadina, A. (Univ., Milan). Int. J. Theor. Phys.; 9: No. 1, 1-17(Jan 1974).

Some unpleasant features of the usual treatment of irreversible processes in quantum mechanics are discussed. It is shown how the description of a nonrelativistic unstable particle can be cleanly embedded into a reversible Galilean quantum field theory. It is proven that in the case of stable particles the embedding procedure gives the same values for internal energy which are obtained by the usual procedure. Finally the technique is applied to the "Galilee" model. (auth)

28580 STRUCTURE OF THE VACUUM SINGULARITY IN REGGEON FIELD THEORY. Abarbanel, H. D. I.; Bronzan, J. B. (National Accelerator Lab., Batavia, IL). Phys. Lett.; 48B: No. 4, 345-348(18 Feb 1974).

The methods of the renormalization group are used to analyze the behavior of all Reggeon proper vertex functions in a Reggeon field theory when all angular momenta are near one or all Reggeon momenta are small. This behavior is governed by an infrared stable Gell-Mann-Low zero which arises when the triple Pomeron coupling is imaginary. A renormalized trajectory must be singular at t = 0, and a variety of scaling laws for the vertex functions are obeyed. Coupling particles to the Reggeons and using the scaling laws it is found to high accuracy that $\sigma_T(s) \sim A(\log s)^{\frac{1}{4}} \times [1 - B/(\log s)^{\frac{1}{4}} \ldots]$ where A factorizes. (auth)

28581 SEPARATION OF VARIABLES IN THE KLEIN–GORDON EQUATION. II. Bagrov, V. G.; Meshkov, A. G.; Shapovalov, V. N.; Shapovalov, A. V. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 45-52(1973). (In Russian).

All types of external nonstationary electromagnetic fields containing arbitrary functions which permit a complete separation of the variables in the Klein-Gordon equation by means of two differential symmetry operators of the first order and one operator of the second order are found. The curvilinear coordinates in which the variables occur are reported, and the equations in the separated variables are given. (tr-auth)

28582 STATICS IN SPECIAL RELATIVITY. Pahor, S.; Strnad, J. (Univ., Ljubljana, Yugoslavia). Nuovo Cim.; 20B: No. 1, 105-112(11 Mar 1974).

A general treatment for relativistic statics is given in the framework of the asynchronous formulation of Cavalleri and Salgarelli. In particular, pivot events are introduced, and the motion of the pivot point is treated in the same way as the motion of a particle. The new definition allows the development of relativistic statics in a form similar to that of its classical counterpart. (auth)

28583 INVARIANCE OF THE CLASSICAL YANG AND MILLS FIELD THEORY. Kerner, R. (Univ., Paris). Compt. Rend., Ser. A, B; 277: No. 22, 1139-1142(5 Dec 1973). (In French).

It is proved that the classical Yang and Mills field equations (i.e. nonquantized) are invariant in relation to discrete transformations corresponding to space reversal, time reversal, and the conjugation of generalized charge. (auth)

28584 STOCHASTIC TREATMENT OF THE QUANTUM MECHANICAL HARMONIC OSCILLATOR: MASS RENORMALIZATION AND LAMB SHIFT. De la Pena-Auerbach, L.; Cetto, A. M. (Univ. Nacional Autonoma de Mexico, Mexico City). Phys. Lett., 47A: No. 2, 183-184(11 Mar 1974).

By studying an oscillator coupled to the fluctuating radiation field, one obtains convergent results for the Lamb shift and for the mass renormalization even before introducing any cut-off. Once in stochastic equilibrium with the field, the oscillator obeys Schrödinger's equation. (auth)

28585 SCALAR WAVE EQUATION IN THE WEAK FIELD APPROXIMATION. Bird, J. M. (Cambridge Univ., Eng.). Phys. Lett., 47A: No. 2, 157-158(11 Mar 1974).

A formula for the retarded solution of the scalar wave equation is given and is shown to differ from the usually accepted approximation. (auth)

Gravitation and General Relativity

Refer also to abstract 27546.

28586 (JINR-E2-7728) GEOMETRY OF LORENTZ ORBIT SPACES. Gheorghe, A.; Mihul, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 36p. Dep. NTIS (U. S. Sales Only) $5.00.

The orbit space of the Lorentz group acting on the product of n real, or complex, Minkowski spaces is stratified into subspaces isomorphic to certain products of Grassmann manifolds and varieties of Gram matrices. The Lorentz orbits (of nonzero dimension) are completely classified by the Stiefel manifolds of standard orthogonal bases for the linear subspaces of the Minkowski space. Several representations of the spaces of n-point Lorentz invariant distributions and differentiable or analytic, functions onto appropriate spaces of distributions and functions of Lorentz invariant variables are also discussed. (auth)

28587 SOME PROPERTIES OF THE GRAVITATIONAL DOUBLE 2-FORM W. Modugno, M. (Univ., Florence). Ann. Inst. Henri Poincare, Sect. A; 18: No. 3, 251-262(1973). (In French).

Some algebraic and differential properties of the double 2-form: $W = R + (1/2)T\Lambda g$ were studied in relation to the Marathe equation: $W + *W* = 0$. Some analogies with the electromagnetic field are considered. The calculation utilizes the external form theory having module values; these values enable certain classical results of Lichnerowicz to be re-established in a complete manner. (FR)

28588 CONSTRUCTION OF NEW SOLUTIONS FOR THE EINSTEIN EQUATIONS BY MEANS OF CONFORMAL DEPICTION. Nosovets, A. V. (Kuban State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 110-114(1973). (In Russian).

On the basis of the structures of the Einstein tensor during conformal depiction, a method was obtained for the construction of new solutions for the Einstein equations. Cases of the conversion of vacuum solutions into hydrodynamic solutions and the latter into solutions of this same type were examined. The necessary and sufficient condition superposed on the vacuum matrix, which guarantees obtaining solutions with the hydrodynamic energy-momentum tensor from the vacuum solution, was found. (tr-auth)

28589 DETERMINATION OF RELATIVE VELOCITIES AND ACCELERATIONS. Dozmorov, I. M. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 86-91(1973). (In Russian).

A comparison was made of the different determinations of relative velocities and accelerations of adjacent moving particles. The Synge determination is preferable and it can be measured by the radiolocation method. (tr-auth)

28590 SELF-GRAVITATING SPINOR CONFIGURATIONS. Ivanenko, D. D.; Gololobova, A. S.; Krechet, V. G.; Lapchinskii, V. G. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 59-62(1973). (In Russian).

The inhomogeneous configurations of the spinor matrix in the natural gravitational field are examined. Special attention is given to the existence of equilibrium spinor configurations (spinor geons). The behavior of nonequilibrium spinor configurations during gravitational compression (collapse) is determined. It is assumed that the spinor linear matrix is described by the general covariant Dirac equation and the linear by the Ivanenko-Heisenberg equation. (tr-auth)

28591 DYNAMICS OF CHARGED DUST IN THE GENERAL THEORY OF RELATIVITY. Ivanenko, D. D.; Krechet, V. G.; Lapchinskii, V. G. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 63-67(1973). (In Russian).

The spherical symmetrical movement of charged dust in the intrinsic gravitational field (analog of the Tolman problem) is studied. Conclusions are drawn on the stopping of the compression of charged dust. (tr-auth)

28592 COSMOLOGIC SOLUTIONS FOR THE SPINOR FIELD IN THE GENERAL THEORY OF RELATIVITY. Ivanenko, D. D.; Gololobova, A. S.; Krechet, V. G.; Lapchinskii, V. G. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 68-71 (1973). (In Russian).

Models of the universe filled with linear and nonlinear spinor matter are examined. It is assumed that the linear spinor matter is described by the general covariant Dirac equation and the nonlinear by the general covariant Ivanenko-Heisenberg equation. (tr-auth)

28593 POSSIBILITY OF DESCRIBING THE GRAVITATIONAL FIELD AS A SPACE OF ABSOLUTE PARALLELISM. Shestopal, V. O. (Novosibirsk Electrotechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 83-85(1973). (In Russian).

Attempts are made to describe space as a space of absolute parallelism. Such a model, appearing stationary, does not require introduction of changes in the gravitational field equations. (tr-auth)

28594 GRAVITATIONAL RADIATION OF ISOLATED SYSTEMS. Dozmorov, I. M. (All-Union Scientific Research Inst. of Optical-Physics Measurements, Moscow). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 47-54(1973). (In Russian).

The gravitational radiation of isolated systems is investigated by introduction of a class of frames of reference analogous to inertial systems in two-dimensional space. Expressions were obtained for the total energy of such systems and the gravitational radiation flux. The fundamental role was shown of Bondi-Metzner-Sachs group with asymptotic symmetry in the general theory of relativity. Their conversion characterizes the transition from one frame of reference of the selected class to another. (tr-auth)

28595 ELECTROMAGNETIC RADIATION FROM AN UNMOVING CHARGE. Chitre, D.M.; Price, R.H.; Sandberg, V.D. (Department of Physics, University of Utah, Salt Lake City, Utah, 84112). Phys. Rev. Lett. 31: No. 16, 1018-1022 (15 Oct 1973).

Gravitational perturbations in the neighborhood of a point charge can induce electromagnetic radiation even if the symmetry of a configuration indicates that the charge is not moving. Wave equations for the electromagnetic radiation are given in the Newman–Penrose formalism, and the radiation for a simple physical system is calculated and discussed. (auth)

28596 WAVE-MECHANICAL FORMULATIONS OF EQUATIONS OF MOTION FOR GRAVITATIONAL SYSTEMS OF MANY PARTICLES. Jehle, H. (George Washington Univ., Washington, DC). Lect. Theor. Phys.; 14B: 309-327(1973).

It is determined whether the hydrodynamical equations of motion for a large number of particle in purely gravitational interaction (i.e., a gravitational system) may be usefully reformulated in terms of a Schroedinger type wave equation. Density and streaming field approaches to gravitational systems, in particular to the developing solar system are treated. (JFP)

28597 LOCALITY AND COVARIANCE IN QED AND GRAVITATION. General Proof of Gupta–Bleuler Type Formulations. Strocchi, F. (Princeton Univ., NJ). Lect. Theor. Phys.; 14B: 551-568(1973).

The quantization of the electromagnetic and gravitational field in the framework of Wightman theory is discussed. The purpose is to clarify the difficulties arising from the zero mass in connection with the gauge group. (JFP)

28598 GEODESIC SYNCHROTRON RADIATION. Breuer, R.A.; Chrzanowski, P.L.; Hughes, H.G. III; Misner, C.W. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 8: No. 12, 4309-4319 (15 Dec 1973).

This paper presents the results and methods of computing the high-frequency radiation emitted by freely falling particles moving in circular geodesic orbits in a spherically symmetric gravitational field. The high-frequency radiation, to which the methods of this paper apply, is the principal part of radiated energy only in the case of a particle moving in a highly relativistic, and therefore unstable, circular geodesic. The geodesic synchrotron radiation emitted in this case shows as main features excitation of high-frequency harmonics and a narrow angular distribution. A Green's-function solution of the scalar wave equation is obtained using WKB methods. For application to relativistic circular orbits a parabolic WKB approximation is required and yields solutions in terms of parabolic cylinder functions. Although only scalar radiation is treated explicitly in this paper, the Green's functions constructed here for the solution of the scalar wave equation also suffice for the vector and tensor calculations. (auth)

28599 S MATRIX FOR GRAVITATIONAL FIELD. II. LOCAL MEASURE; GENERAL RELATIONS; ELEMENTS OF RENORMALIZATION THEORY. Fradkin, E.S.; Vilkovisky, G.A. (Physical Lebedev Institute—Academy of Sciences—Moscow, USSR). Phys. Rev. D 8: No. 12, 4241-4285 (15 Dec 1973).

A method is suggested for obtaining the local measure in the generating functional for nonlinear gauge fields within the framework of covariant *S*-matrix theory. The local measure is obtained explicitly for the case of the gravitational field. The measure obtained is proved to cancel all the divergences of the type $\delta^{(n)}(0)$ which arise in the theory due to its nonlinearity. It is proved that the value of the measure that is obtained is also required by the canonical formalism for gauge fields, and thus it secures the unitarity of the *S* matrix. A new version of the canonical formalism for the gravitational field is given, which leads to the explicit Hamiltonian in terms of independent canonical variables. The quantization procedure in this approach to the canonical formalism is just the usual canonical quantization carried out in the Lorentz-covariant gauge. The new canonical formalism directly gives the value of the local measure in the Feynman integral. It is proved that besides securing the unitarity of the *S* matrix and eliminating the strongest divergences, the local measure obtained secures the gauge independence of the *S* matrix. This property results from the fact that the Jacobian of the gauge transformation of the field differentials is not equal to unity, contrary to the statement in previous works. The gauge transformation of the local measure exactly compensates for this Jacobian. The consequences of the gauge invariance of the theory are studied next. The complete set of generalized Ward identities for the Green's functions is obtained in the transverse gauge. The set of quantum equations of motion for the gravitational field is derived, and the problems connected with these equations are discussed. In the framework of the first-order formalism, the quantized Einstein equations are shown to take the form of the Schwinger-Dyson equations. A set of gauge relations for bare vertices is obtained. The analysis of the generalized Ward identities for the Green's functions at the threshold is given. In this connection the gravitational and fictitious-field wave-function renormalization constants Z_2 and $\tilde{Z}_2$ as well as the fictitious interaction vertex renormalization constant $\tilde{Z}_1$ and the infinite number of graviton vertex renormalization constants $Z_1, Z_1^{(2)}, \ldots, Z_1^{(n)}, \ldots$ are introduced. An infinite set of Ward relations for these renormalization constants is obtained, $Z_1 Z_2^{-1} = \tilde{Z}_1 \tilde{Z}_2^{-1}$, $(Z_1^{(n)})^{-1} = Z_1^{-n} Z_2^{n-1}$, which leaves only two independent renormalization constants Z_1 and Z_2 and secures the gauge invariance of the renormalized theory. Further, the new invariance properties of the quantum theory of the gravitational field are investigated, which are connected with peculiarities of the symmetry breaking and with the existence of the dimensional Planck length. The "scale" invariance or "homogeneity" of the theory is proved, which leads by means of Euler's theorem to a new infinite set of relations, obeyed by the Green's functions. Analysis of these relations at threshold gives a new identity for the renormalization constants: $Z_1 = Z_2$. Using the fact that the gravitational constant enters the theory only through the dimensionless space-time coordinates, the general off-mass-shell relations for the Green's functions are obtained from the "scale" identities. Possible anomalous singularities of the Green's functions are investigated. The "scale"-invariant regularization is introduced. It is also proved, using the "homogeneity" properties, that the renormalization constants do not depend on the gauge. As a result, the threshold asymptotic behavior of all Green's functions of the theory are made finite by means of only one renormalization constant—that renormalizing the gravitational constant κ. (auth)

28600 COMMENT ON THE JAFFE–SHAPIRO DEFINITION OF VELOCITY. Baierlein, R. (Wesleyan University, Middletown, Connecticut 06457). Phys. Rev. D 8: No. 12, 4639-4641 (15 Dec 1973).

How should one define the speed of a freely falling particle as measured by an observer who is far from the gravitating body? Jaffe and Shapiro offered an answer, one which says that a very fast particle slows down as it falls. The present paper first offers an alternative definition, one which implies that both slow and fast particles speed up as they fall. Then the paper argues that the defining procedure of Jaffe and Shapiro is incomplete and that, when completed in an invariant manner, will yield a substantially different behavior. (auth)

28601 CALCULATION OF THE GRAVITON SELF-ENERGY USING DIMENSIONAL REGULARIZATION. Capper, D.M.; Leibbrandt, G.; Medrano, R. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev. D 8: No. 12, 4320-4331 (15 Dec 1973).

One-loop contributions to the graviton self-energy are calculated, in the context of covariant quantization, by employing a modified technique of dimensional regularization and by extending Goldberg's version of the Einstein Lagrangian to n dimensions. It is shown that the sum of the graviton and fictitious-particle contributions to the graviton propagator satisfies Slavnov–Ward identities and that the finite part of this sum can be extracted in a manner consistent with these identities. There are no infrared problems in off-mass-shell Green's functions, and tadpole contributions can consistently be put to zero. (auth)

28602 COMMENT ON THE DEFINITION OF PARTICLE VELOCITY IN A SCHWARZSCHILD FIELD. Jaffe, J. (Department of Physics, Boston College, Newton, Massachusetts 02167); Shapiro, I.I. Phys. Rev. D 8: No. 12, 4642-4643 (15 Dec 1973).

The definition we previously introduced to describe the velocity of a test particle in a Schwarzschild field, as measured by a distant observer, is shown to be complete. As we desired, this definition reflects the fact that round-trip times-of-flight of fast test particles will be longer when governed by general relativity than when governed by a Minkowskian or Newtonian theory. In this sense, particles obeying general relativity

appear to slow down. The alternate definition of particle velocity proposed by Baierlein does not have this property and is shown to be more appropriate for a local observer than for a distant observer. (auth)

28603 EXTREME RELATIVISTIC LIMIT FOR GRAVITATIONAL RADIATION FROM AN ELECTROMAGNETICALLY BOUND SYSTEM: ERRATA AND ADDENDA. Peters, P.C. (Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. D 8: No. 12, 4628-4631 (15 Dec 1973).

Numerical computations for gravitational radiation from a charge executing circular orbits in a Coulomb field, given in a recent paper, are corrected. Analytic expressions for the radiation in the extreme relativistic limit are developed and compared with the results of Khriplovich and Sushkov. (auth)

28604 FEYNMAN QUANTIZATION AND S-MATRIX FOR SPIN PARTICLES IN RIEMANN SPACE-TIME. Menskii, M. B. (All-Union Scientific Research Inst. for Physical-Technical and Radiotechnical Measurements, Moscow). Teor. Mat. Fiz.; 18: No. 2, 190-202(Feb 1974). (In Russian).

The Feynman space-time interpretation of quantum field theory is extended to the case of general Riemann space-time (external gravitational field). The expression in the form of a functional integral for the causal propagator is deduced by means of the proper time method and a correspondingly generalized path integral method. The interpretation of the Feynman diagrams in terms of particles and antiparticles is done in such a way that the usual space-time properties of the causal propagator (the forward movement in time of particles and backward movement in time of antiparticles) take place. The expression for the amplitude of the creation of the pair in the external gravitational field, including the instability and degeneration of the vacuum, is deduced. It is shown that vacuum instability is absent at least for closed 3-dimensional space. (auth)

28605 EFFECT OF THE ROTATION OF THE CENTRAL BODY ON THE ORBIT OF A PARTICLE. Breen, B. (Imperial Coll. of Science and Tech., London). J. Phys., A (London); 7: No. 2, 216-222(21 Jan 1974).

The general postnewtonian metric expansion of Nordtvedt is modified in such a way that the effects of the rotation of the central body on the orbit of a test particle can be examined. This enables formulas to be found for the additional advance of the perihelion and rate of precession of the normal of the orbit about the axis of rotation in general relativity and in the Brans-Dicke and Nordtvedt scalar-tensor theories. In the case of general relativity the rate of precession is found to be half the value previously given by Lense and Thirring (Phys. Z.; 19: 156-63(1918)). (auth)

28606 MICROGEONS WITH A SPIN. Burinskii, A. Ya. Zh. Eksp. Teor. Fiz.; 66: No. 2, 406-411(Feb 1974). (In Russian).

A geon with an angular momentum is considered. Respective approximate solutions of the Maxwell-Einstein equations are obtained which are a wave generalization of the stationary Kerr-Newman metric. (auth)

28607 TEORIYA GRAVITATSII I PRINTSII EKVIVALENTNOSTI. (Gravitational Theory and Equivalence Principle. Lorentz Group, Einstein Group, and Space Structure). Treder, G. Yu. Moscow; Atomizdat (1973). 168p.

A thorough analysis is given of the equivalence principle proposed by Einstein as a basis of his gravitational theory-the general relativity theory. The axiomatics of the general theory of relativity are not yet constructed. Fundamental questions of the contemporary theory of gravitation are examined. Concepts, significance, and dynamics of the development of the equivalence principle in gravitation are analyzed. The connection of the equivalence principle with other problems of gravitation is illustrated. A history of the questions and origins of different gravitational theories is given. (tr-auth)

28608 CYLINDRICALLY SYMMETRIC CHARGED PERFECT-FLUID DISTRIBUTION IN GENERAL RELATIVITY. Singh, K. P.; Upadhyay, R. C. (Banaras Hindu Univ., India). Indian J. Phys.; 47: No. 7, 408-412(Jul 1973).

A solution of Einstein-Maxwell field equations in cylindrically symmetric space-time is derived for the perfect fluid case. Expressions for material density and charge density were explicitly found. (auth)

28609 NOTE ON THE ESCAPE OF NEUTRINOS FROM WITHIN EINSTEIN'S SPHERICAL CLUSTER OF GRAVITATING MASSES. Hoga, P. A. (Dublin Inst. for Advanced Studies). Proc. Roy. Irish Acad., Sect. 73A: No. 8, 91-97(1973).

It is shown that neutrinos emitted outwards from within Einstein's spherical cluster, making any angle in the range $(0, \pi/2)$ with the radial direction, escape to infinity. A new derivation of the energy tensor for the cluster is also given. (auth)

28610 CAUCHY PROBLEM FOR THE BOLTZMANN EQUATION IN GENERAL RELATIVITY. Bancel, D. (Univ., Toulouse). Ann. Inst. Henri Poincare, Sect. A; 18: No. 3, 263-284(1973). (In French).

The Cauchy problem for the nonlinear Boltzmann equation is investigated by means of a functional analysis technique appropriate to the coupling with Einstein's equation. (auth)

28611 GENERALISED CONFORMAL TRANSFORMATIONS. Soleimany, A. K. (King's Coll., London). J. Phys., A (London); 7: No. 2, 223-230(21 Jan 1974).

A technique is developed which allows a unified treatment of null, spacelike and timelike infinities. Null and spacelike infinities have previously been treated using such techniques. The technique is applied to the projective structure of timelike infinity and a number of examples worked out. (auth)

28612 SPACE-TIMES CONTAINING A FIELD OF ISOTROPIC RECURRENT VECTORS. Leroy, J. (Univ., Libre, Brussels); McLenaghan, R. G. Bull. Cl. Sci., Acad. Roy. Belg.; 59: No. 7, 584-610(1973). (In French).

The space-times which admit a recurrent null vector field and which are solutions of Einstein's equations with cosmological constant, Λ, are determined for an energy-momentum tensor of the form $\rho u^a u^b$. A coordinate system is given in which the metric of these space-times depends upon two arbitrary functions and the constant Λ. The Weyl tensor is of Petrov type III or N if $\Lambda = 0$, and of type II or D if $\Lambda \neq 0$. The metric of type D is determined explicitly and also the metric of type III for which the nonrepeated eigenvector of the Weyl tensor is geodesic. The metrics for which $\rho \neq 0$ may be considered as solutions of Einstein's equations with a singular electromagnetic field as source. For these space-times Maxwell's equations are solved. The metrics of the space-times for which $\rho = 0$ are also determined. (auth)

28613 SPHERICALLY SYMMETRIC SOLUTIONS OF EINSTEIN-MAXWELL THEORY WITH NULL FLUID. Tupper, B. O. J. (New Brunswick Univ., Fredericton). Int. J. Theor. Phys.; 9: No. 1, 69-74(Jan 1974).

Solutions of the Einstein-Maxwell equations with the addition of terms representing charged null fluid emitting from a spherically symmetric body are found. One type of solution is a simple extension of that found by Bonnor and Vaida (Gen. Rel. Grav.; 1: 127 (1970)) while the other represents a null electromagnetic field with null electric current. (auth)

28614 SINGULARITIES IN WEYL GRAVITATIONAL FIELDS. Cooperstock, F. I.; Junevicus, G. J. (Univ. of Victoria, B. C.). Int. J. Theor. Phys.; 9: No. 1, 59-68(Jan 1974).

The peculiarities of the scalar $S = R_{ijkl}R^{ijkl}$ are exhibited for two axially-symmetric static (Weyl) gravitational fields. By examining S along curved families of trajectories to the Weyl singularities, examples are found which contradict previous claims by Gautreau and Anderson (Phys. Lett. 25A: 291 (1967)) regarding "directional singularities". Proper circumferences about the Bach and Weyl line-mass singularity are also examined. There is no apparent correlation between the source structure and the behavior of S from this analysis. (auth)

28615 GRAVITATION AND OTHER FIELD THEORIES. Groenewold, H. J. (State Univ., Groningen, Netherlands). Int. J. Theor. Phys.; 9: No. 1, 19-45(Jan 1974).

Relations between the Einstein theory of gravitation in curved Riemann time-space and classical field theories in flat Minkowski time-space are discussed from various points of view. (auth)

28616 REPRESENTATION OF THE DIRAC ALGEBRA FOR A LATTICE SPACE-TIME. Pietenpol, J. L. (Univ., Louvain, Belgium). Ann. Soc. Sci. Brux. Ser. I; 88: No. 1, 63-70(1974).

The algebra of matrices occurring in the finite-difference Dirac equation proposed by Meessen for a cubic space-time lattice is studied. It is found that no matrix representation exists for the algebra as originally given. A slightly weaker set of relations admits an essentially unique irreducible representation of dimension 16. (auth)

28617 GENERALIZING RIEMANNIAN GEOMETRY. Hudgin, R. H. (State Univ. of Buffalo). J. Math. Phys. (N.Y.); 14: No. 12, 1794-1799(Dec 1973).

The properties of Riemannian geometry necessary to relativity were used as a basis to derive a more general geometry. Emphasis is placed on a natural development with the result of considerable generalization. Several examples are discussed including the Brans-Dicke field equation, which are but one special case of the new manifolds. The scalar field is not introduced ad hoc but is a natural geometrical quantity. (auth)

28618 THEORY OF GRAVITATION INCORPORATING THE QUADRATIC ACTION PRINCIPLE: FURTHER EXACT SOLUTIONS. Wynne, V. A. (Univ. of Waterloo, St. John's Newfoundland). Nuovo Cim.; 20B: No. 1, 93-104(11 Mar 1974).

The theory of gravitation developed previously rests upon the hypothesis that any permissible metric field whatsoever must satisfy some self-contained set of field equations which, it is proposed, are provided by a quadratic action principle. The set of exact, spherically symmetric, static solutions of these equations is now extended to include all those which belong to Takeno's «class 2». The surface area of a sphere in such a space-time has a value which does not depend upon the radial coordinate.(auth)

28619 MACH'S PRINCIPLE FOR ROTATION. Pietronero, L. (Univ., Rome). Nuovo Cim.; 20B: No. 1, 144-148(11 Mar 1974).

The interpretation of rotation from a Machian point of view seems to imply the presence of masses faster than light because, for sufficiently large distances, $\Omega r > c$, when Ω is fixed. This has generated the opinion that the rotation contains some absolute features. It is shown here that the imposition of a true physical reciprocity between the two points of view of a rotating object and a rotating universe leads to a nonconstant Ω. One obtains in fact $\Omega(r) = \Omega_0/\sqrt{1 + \Omega_0^2 r^2/c^2}$ so that for $r \to 0$, $\Omega(r) \to \Omega_0$ and for $r \to \infty$, $\Omega(r)r \to c$; the problem is therefore automatically overcome. (auth)

28620 SYSTEMS RIGID ACCORDING TO SYNGE IN THE THEORY OF RELATIVITY. Dozmorov, I. M. (All-Union Scientific Research Inst. of Optical-Physics Measurements, Moscow). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 55-60(1973). (In Russian).

The properties of frames of reference based on particles with a velocity constant along the isotropic cone and with a vertex lying on the mirror line of one of the particles are investigated. Such systems are called rigid by Sing. Criteria are formulated for the detection of such systems in the general theory of relativity. (tr-auth)

28621 DERIVATION OF THE ABRAHAM ELECTROMAGNETIC ENERGY-MOMENTUM TENSOR. Corinaldesi, E. (Boston Univ.). Compt. Rend., Ser. A, B; 277: No. 21, 1083-1085(26 Nov 1973). (In French).

An extension of the Belinfante method for the symmetrization in space-time of the energy-momentum tensor for a system having no rotational or translational symmetry is described. The application of the extension to a magnetic field in a homogeneous material medium leads to the Abraham tensor. (auth)

28622 FINITE NEUTRINO REST MASS FROM GENERAL RELATIVITY. Sivaram, C.; Sinha, K. P. (Indian Inst. of Science, Bangalore). Curr. Sci. (India); 43: No. 6, 165-168 (20 Mar 1974).

The weak interaction having the universal Fermi coupling constant and mediated by a massive intermediate boson is related to the metric of the surrounding space-time through a line element analogous to the well known Reissner–Nordström line element for the electromagnetic interaction. Together with a fundamental beta-decay length this predicts a finite rest mass for the neutrino which is well within experimental upper limits. The corresponding intermediate boson mass is also obtained. Further, making use of the line element for a particle with "Yukawa charge", the pion-proton mass ratio is obtained. (auth)

REACTOR TECHNOLOGY AND REGULATION

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 28735, 28737, 28767, 28771, 28772, 28774, and 28778.

28623 (CEA-CONF-2508) AREAS OF USE OF COLLECTRONS IN LIGHT WATER POWER REACTORS. Verdant, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France)). 24 Sep 1973. 15p. (In French). (CONF-731059-1). Dep. NTIS (U.S. Sales Only) $3.00.

From 41st meeting of the French dosimetry group; Bugey, France (16 Oct 1973).

The development of nuclear power plants necessitates a simple and reliable neutron control instrumentation. Moreover the size of reactors requires more and more in-core detectors. The collectrons are advantageous from economic and reliability viewpoints. The actual experience with different types of collectrons makes it possible to define their areas of use as a function of the characteristics of sensitivity, longevity, and response time. After a review of the operational principles and a technological description of these detectors, the emphasis is placed on the contribution of cables as a function of their diameters and component materials. (tr-auth)

28624 (DOCKET-50293-242) PILGRIM NUCLEAR POWER STATION, UNIT 1. Primary Coolant Boundary Leakage Monitor System Evaluation After First Year of Commercial Operation. (Boston Edison Co., Mass. (USA)). 11 Mar 1974. 8p. Dep. NTIS $3.00.

The operating events involving the reactor coolant leakage monitoring systems are reviewed for the first year of station commercial operation. (auth)

28625 FULL LOAD TESTING OF PRIMARY COOLANT PUMPS FOR NUCLEAR POWER PLANTS. Dernedde, R.; Gaffal, K.; Kiehn, U. Technical Meeting No. 1/8. Basel; Nuclex (1972). 10p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

With increase in power reactor size there is increasing requirements on pump size and performance. The advantages and disadvantages of a model study of pumps to determine their characteristics under increased full load are outlined. The design of an installation for the full load testing of pumps is described. (JSR)

28626 VARIABLE-FREQUENCY MOTOR-GENERATOR SETS FOR REACTOR RECIRCULATION PUMPS. Sanae, S.; Makino, M.; Hasegawa, H.; Koide, M. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Toshiba Rebyu; 29: No. 1, 58-62(Jan 1974). (In Japanese).

Variable-frequency motor-generator sets are used for controlling the speed of pumps that recirculates water through boiling-water nuclear reactors. The control of the pumps speed varies the recirculating water flow, which, in turn, regulates the steam-generation rate that directly affects the reactor power level. The motor-generator sets are described. The special factory tests carried out for demonstrating and evaluating the performance of the sets are discussed. (auth)

28627 DESIGN AND CONSTRUCTION OF FACILITIES FOR SIMULATING BLOWDOWN IN LOSS OF COOLANT ACCIDENTS IN WATER-COOLED REACTORS. Ikeda, M.; Hozumi, M. (Sumitomo Shipbuilding and Machinery Co. Ltd., Tokyo). Sumitomo Jukikai Giho; 20: No. 58, 28-31(Oct 1972). (In Japanese).

Japan Atomic Energy Research Institute has been making experiments on the loss of coolant accident in water-cooled reactor, maximum credible accident. The experiment are called "ROSA program". Sumitomo Shipbuilding & Machinery Co., Ltd. designed and constructed facilities for experiments in 1970. The ROSA program intends to simulate artificially the blow-down phenomena at the loss of coolant accident. The outline of the facilities is described. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 28623, 28625, 28627, 28746, 28748–28750, 28769, 28770, 28773, and 28775–28777.

28628 (BAW-10080) CADD: COMPUTER APPLICATION TO DIRECT DIGITAL SIMULATION OF TRANSIENTS IN WATER REACTORS. Stoudt, R. H.; Busby, S. E. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Mar 1974. 49p.

The CADD Fortran program solves the time-dependent neutron kinetics equations in conjunction with the thermal-hydraulic equations for an average fuel pin during a reactivity transient in a pressurized water reactor (PWR). The simulation includes the major feedback mechanisms as well as detailed single-phase, nucleate boiling, and film boiling core heat transfer models. CADD is also capable of simulating the entire reactor coolant loop, including the pressurizer. (10 references) (auth)

28629 (EUR-5003) RESEARCH PROGRAM INTEGRATIVE OF THE ENEL PROGRAM ON THE TRINO VERCELLESE REACTOR. Final Report. Basile, F.; Buonaugurio, G.; Claps, M.; de Serafini, M.; Fedrighini, A. C.; Moncassoli Tosi, A. M.; Pelassa, G.; Pozzi, G. P.; Rama, P. G.; Selvaggi, G. (Fiat, Turin (Italy). Sezione Energia Nucleare). 1974. 193p. Dep. NTIS (U.S. Sales Only) $11.75. EUR B.Fr. 250.-.

The main results obtained in the framework of the Euratom Fiat contract on the Trino Vercellese reactor are presented. The aim of Fiat calculation was to provide the European Community with up-to-date and reliable means for determining the nuclear characteristics of pressurized water reactors. The experimental results obtained at Enel's Trino Vercellese Nuclear Power Plant during two operating cycles are successfully compared with theoretical predictions. The reliability of the theoretical approach is demonstrated. (72 references) (auth)

28630 (WCAP-8279) HYDRAULIC FLOW TEST OF THE 17 x 17 FUEL ASSEMBLY. De Mario, E. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Feb 1974. 111p.

A full scale prototype 17 x 17 fuel assembly was tested in a hydraulic loop to verify the design under operating flow conditions. The assembly successfully passed all flow test requirements proving the 17 x 17 fuel assembly design is conservative and has margin for increased performance. (auth)

28631 AUTOMATIC BORON ANALYZER FOR PRESSURIZED WATER REACTORS. Schneider, K. Technical Meeting No. 1/16. Basel; Nuclex (1972). 11p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A boron analyzer which has been tested under practical conditions is described. The analyzer is suitable to measure directly the boric acid content in PWR reactors. The measured values are reported in digital or analog form for data processing. (tr-auth)

28632 EXPERIENCE ON THE DEVELOPMENT OF PRIMARY PUMPS FOR REACTORS UP TO 1200 MW(e). Forien, M.; Lepert, C. Technical Meeting No. 1/14. Basel; Nuclex (1972). 16p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A prototype pump for use with reactors up to 1200 MW(e) was developed. The characteristics are briefly but completely outlined. The basic hydraulic problems encountered in the design and construction are discussed. The further studies planned are outlined. (JSR)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 27258, 28733, 28734, and 28768.

28633 (AEC-tr-7520) RELIABILITY RESULTS DRAWN FROM THE E.D.F. ST. LAURENT DES EAUX PLANT ACCIDENT FILE. Blin, A. (USAEC Technical Information Center, Oak Ridge, Tenn.). Oct 1973. Translation of SETS-24. 30p. Dep. NTIS $3.50.

A computer-storage information file on deterioration or failures of materials or components in the St. Laurent Plant has been maintained. This data was analyzed to give reliability information on components of interest for reactor safety. The results of the analysis are presented. (JWR)

28634 (CEA-CONF-2525) FISSION GAS PRESSURE EVOLUTION IN IRRADIATED COATED PARTICLES. Janvier, J. C.; Bruet, M.; Blanchard, R. (CEA Centre d'Etudes Nucleaires de

Grenoble, 38 (France). Dept. de Metallurgie). 25 Jul 1973. 14p. (CONF-731004-9). Dep. NTIS (U.S. Sales Only) $3.00.

From international conference on nuclear fuel performance; London, UK (15 Oct 1973).

Different methods were used in order to determine the internal pressure of the stable fission gases and its evolution. Results show that the fractional internal release from the kernel obeys a law proportional to the burnup and that the internal free volume available to the gases in the particle increases with fast neutron dose. This increase in free volume may be interpreted as the result of a densification of the internal pyrocarbons under the neutron flux. The evolution laws of the free volume and of the fractional internal release may be combined to predict the variation of the partial pressure of the rare fission gases for a given particle. (6 figures, 3 tables) (DLC)

28635 (CONF-740501-2) ENVIRONMENTAL IMPACT OF HTGR POWER STATIONS. Kelly, M. J.; Kirslis, S. S.; West, R. G. (Oak Ridge National Lab., Tenn. (USA); USAEC Directorate of Licensing, Washington, D.C.). [nd]. 9p. Dep. NTIS $4.00.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (8 May 1974).

The high-temperature gas-cooled reactor power station has all of the potential environmental impacts associated with any large nuclear station. Construction impacts can be minimized by proper planning and are usually of limited duration. The potentially most significant impacts of station operation result from the operation of the heat dissipation system. The use of cooling towers is assumed. The effects of salt deposition, fogging, and icing are expected to be minor. The magnitude of the adverse effects caused by intake and discharge such as entrainment of eggs, larvae, and fish and chemical impacts from blowdown can only be assessed for a specific site but may be significant. The impact of radionuclide releases, constrained by the as-low-as-is-practicable criteria, is small. The only potential environmental advantage over other reactor types is lower consumptive water use for the same net electric power production. (auth)

28636 (GA-A-12692(Supp.A)) OPERATION OF THE CONTEMPT-G CONTAINMENT ANALYSIS PROGRAM ON THE UNIVAC 1108 COMPUTER. Houghton, W. J.; Turner, C. L. (General Atomic Co., San Diego, Calif. (USA)). 8 Feb 1974. 277p.

The CONTEMPT-G computer program predicts transient pressures and temperatures occurring in HTGR containments during assumed design basis depressurization accidents. It also predicts conditions during other postulated accidents. The use of the program, i.e., how to prepare the input and interpret the printed output is presented. Sample problems are provided as an aid to understanding the descriptions of input and output. (auth)

28637 (GA-A-12822) PUBLIC SERVICE COMPANY OF COLORADO 330-MW(e) HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending December 31, 1973. (General Atomic Co., San Diego, Calif. (USA)). 31 Jan 1974. Contract AT(04-3)-633. 55p. Dep. NTIS $4.00.

Progress during the quarter on the research and development program for the Public Service Company of Colorado 330-MW(e) High-temperature Gas-cooled Reactor is described. The work includes studies of component development, such as auxiliary equipment and special tools, and nuclear analysis of the fuel cycle, fuel zoning, and power shaping. The fuel development and fuel element proof testing portions of the report include demonstration testing of the performance of test fuel elements by means of irradiation at expected operating temperatures and capsule irradiation tests of production fuel. Studies covering the components of the steam generator under operating conditions are included. Experimental procedures and results are discussed and, where appropriate, the data are presented in tables, graphs, and photographs. (auth)

28638 (GA-A-12877) PRESENT THORIUM-CYCLE FUEL CONCEPTS AND PERFORMANCE LIMITATIONS. Gulden, T. D.; Scott, J. L.; Moreau, C. (General Atomic Co., San Diego, Calif. (USA)). 1 Feb 1974. Contract AT(04-3)-167. 28p. (CONF-740501-1). Dep. NTIS $3.50.

From ANS topical meeting on gas-cooled reactors: HTGR and GCFBR; Gatlinburg, Tennessee, USA (8 May 1974).

Fuel for the thorium-cycle HTGR has evolved from the partially segregated fuel used in the Peach Bottom and Fort St. Vrain reactors to complete segregation of fissile and fertile species in separate coated particles for the current generation of large commercial HTGRs. The extensive fuel development and test programs for the early HTGRs provide a technology base for the current fuel. All significant changes from this base technology, which have resulted from efforts to optimize the fuel cycle, have now been successfully demonstrated in irradiation tests to and beyond peak design exposures. The performance of the fuel particles is limited by irradiation-induced mechanical stresses and by chemical reactions, including the amoeba effect. Models are available to describe most of these phenomena with varying degrees of accuracy. Normalization of the models with experimental results provides a firm basis for predicting fuel performance. A number of potential improvements in the coated particle fuel are under investigation both in the United States and Europe. These developments offer significant promise for improving HTGR fuel with respect to performance, fission product retention, and economics. (auth)

28639 (GULF-GA-A-12808(Vol.1)) LARGE HTGR STEAM GENERATOR DESIGN VERIFICATION AND SUPPORT PROGRAMS. Summary. Schultz, G. M. (Gulf General Atomic Co., San Diego, Calif. (USA)). 15 Dec 1973. 44p.

Information on the HTGR steam generator design verification and support programs is presented under the following headings: HTGR steam generation system; steam generator design; heat transfer and fluid flow verification and support programs; materials verification and support programs; and vibrations verification and support programs. (DCC)

28640 (GULF-GA-A-12808(Vol.2)) LARGE HTGR STEAM GENERATOR DESIGN VERIFICATION AND SUPPORT PROGRAMS. Heat Transfer, Fluid Flow, and Stability. Schultz, G. M. (Gulf General Atomic Co., San Diego, Calif. (USA)). 15 Dec 1973. 155p.

The design of the steam generators for the large High-Temperature Gas-Cooled Reactor (HTGR) is based on significant amounts of experience and data obtained throughout the world. Gulf General Atomic and Foster Wheeler believe that the available data and experience, in conjunction with the testing programs discussed, provide a firm basis for the heat transfer and fluid flow design of the large HTGR steam generators. A brief description of the large HTGR steam generator is given. A discussion of the analytical methods used is given to provide a basis for the subsequent discussion of the testing programs. The heat transfer and fluid flow verification and support programs include the following: verification of the heat transfer and fluid flow correlations used in the computer codes NUSIZE, SUPERHEAT, and DYNAM; and verification of the heat transfer, pressure drop, and stability analysis performed with SUPERHEAT and DYNAM. The analysis used in the design and performance evaluation of the large HTGR steam generator is based on existing data and empirical relations concerning flow distribution, gas mixing, bypass flow, etc. The performance tests are designed to verify the validity of the data and relationships by testing geometric and flow conditions that are dynamically similar or identical to the large HTGR. Each program is discussed separately and is presented to identify the areas where existing data are directly applicable to the large HTGR and to describe the testing programs for the areas that require additional verification. (auth)

28641 (GULF-GA-A-12808(Vol.4)) LARGE HTGR STEAM GENERATOR DESIGN VERIFICATION AND SUPPORT PROGRAMS. Vibrations. Kaufman, J. S. (Gulf General Atomic Co., San Diego, Calif. (USA)). 15 Dec 1973. 61p.

The objective of the vibrations program for the steam generator is to verify that vibratory stresses due to aerodynamic, acoustic, and seismic excitation forces will be within acceptable limits over the life of the HTGR plant, and to assure that adequate wear protection is provided at points of contact between adjacent components where vibrations can be tolerated. The current vibration program is an extension of the Fort St. Vrain program. Additional vibration tests now in progress will provide further support to the vibration analysis. Computer models of the various components are being constructed for the appropriate computer programs, and vibration stresses and deflections are being calculated. Inputs for excitation forces and frequencies, as well as damping, have been extracted from Fort St. Vrain test programs. The current test programs are connected with extending the knowledge of excitation forces, damping, and tube protection to the specific configurations of the large HTGR. These tests are also intended to improve the basic understanding of mechanisms causing flow-induced vibration. As test data become available, it will be possible to verify the conservatism employed in the vibration analysis. (auth)

28642 (JUL-1002-RG) INFLUENCE OF THE MAIN PARAMETERS OF A SINGLE-CYCLE GAS TURBINE POWER PLANT ON PLANT EFFICIENCY AND MASS FLOW. Heil, J. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Sep 1973. 86p. (In German). Dep. NTIS (U. S. Sales Only) $6.50.

A single-cycle gas turbine power plant is considered and the influence of the different parameters of the main cycle on plant

efficiency and mass flows is investigated with the help of a computer program. Starting with a basic set of parameters, individual parameters are varied, and the dependence of efficiency and mass flows on the parameter is plotted in diagrams. Plants with zero, one, or two intercoolers in the compression stage are considered. It turns out in general that plants with no intercoolers depend most sensitively, and those with two intercoolers least sensitively, on changes in the parameters. For different choices of parameters, the efficiency of a plant with one intercooler exceeds that of a plant with no intercooler by about 4.5 points in efficiency. A further improvement of only 1.8 points results from adding a second intercooler. Simple approximate formulas are derived from the diagrams and permit quick assessment of the influence of changing one or more parameters. An example of the application of these approximate formulas is given. (GE)

28643 (RD/B/N-2514) DESIGN, DEVELOPMENT, AND CALIBRATION OF A THERMOCOUPLE PROBE FOR THE MEASUREMENT OF SURFACE TEMPERATURE DISTRIBUTIONS IN ROD CLUSTERS. Stephens, M. J.; Birt, P. J.; Smith, S. L.; Pirie, M. A. M. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1973. 36p. (RPC/HT/N-(73)19). Dep. NTIS (U.S. Sales Only) $4.00.

A thermocouple probe developed for measuring surface temperature distributions in A.G.R. cluster heat transfer experiments is described. The probe is located on the bore of a pin and has nine sensing elements equally spaced around its circumference. Each sensing element is spring-loaded against the inner wall of the pin to ensure good thermal contact. The probe can be traversed over the length of a pin enabling temperature surveys to be speedily carried out. Proving tests were conducted to establish the magnitude of three sources of error due to bus-bar heating and conduction damping effects, and to provide a calibration if necessary. It is concluded that as a result of bus-bar heating effects the thermocouple probe records a temperature higher than the true pin bore temperature by 12% ± 2% of the temperature difference between the bus-bar and pin. For a current of 300 amps, typical of the maximum used in cluster heat transfer tests, differences of 2°C ± 0.3°C are implied. The above figure can be used as a calibration to correct probe temperature measurements. Other conclusions are that the presence of the thermocouple probe does not damp the circumferential temperature variation in the pin, and that the probe does accurately measure the latter provided correction is made for bus-bar heating effects. (UK)

28644 (RD/B/N-2638) DISPEC: A METHOD OF CORRECTING ONE-THERMAL-GROUP AGR CROSS-CLUSTER RATING GRADIENTS. Theory and Justification. Howarth, N. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1973. 49p. (RPC/RPNK/P-(73)38). Dep. NTIS (U. S. Sales Only) $4.50.

The spectrum error present in one thermal energy group calculations of the cross-cluster rating tilt in an AGR type reactor is investigated. A range of consistent heterogeneous (HET) calculations using up to 10 thermal groups has been carried out on 4 AGR-type reactors assembled at Berkeley Nuclear Laboratories. The largest difference observed were in channels next to an interstitial rod or in-channel vacancy where the one thermal group calculation underestimated the gradient by 20–25%. Channels away from singularities were underestimated by 10%. An idealized calculation indicated that in the outer region of a CAGR overestimates of up to 40% could occur. A method of correcting the output of a normal 2 or 3 group HET calculation is presented. This method (DISPEC, DIPole SPECtrum) has been tested against the full multigroup calculation and the residual errors assessed as 2% and 3% when applied to 3 and 2 group HET calculations respectively. Because of the need for multigroup data the present studies have been limited to the use of the WIMS lattice code. For incorporation into the normal CAGR calculational route it will be necessary to extract the required multigroup data from ARGOSY. A method of doing this is presented in an appendix. (auth)

28645 STRUCTURAL MATERIALS FOR HTGR TYPE REACTORS. Nakanishi, T. (Fuji Electric Co. Ltd., Kanagawa, Japan). FAPIG (Tokyo); No. 69, 16-22(May 1973). (In Japanese).

In the HTGR type reactors such as the DRAGON reactor, the solution of the problems of the strength of the structural materials at the high temperature condition as well as the reactions of such materials with the impure gases being contained inevitably in the He coolant is very important. A summary of the latest information is presented related to the reactions of the materials with the impurities in He. It contains the brief thermodynamical fundamental explanation about the reactions, the detailed disclosures about the comparisons of the results between oxidated materials in the laboratory test and those of in the practical DRAGON reactor, and the effects to the creep strength of the materials; and the outlines about the problems of fatigue and tribology (phonetic). (JA)

28646 AGR IN JAPAN. Joss, J. O. FAPIG (Tokyo); No. 68, 224-237(Feb 1973).

From joint meeting between British Nuclear Forum and Japan Atomic Industrial Forum; Tokyo, Japan (11 Dec 1972).

As many advantages in AGRs were recognized by EPDC and FAPIG, the detailed design of an AGR has been proceeded by TNPG and FAPIG. The results of this study are described. Changes from Hinkley Point B design so that it can be pertinent for its installation in Japan are minor, however. Taking special consideration for seismic environment, emphasis in the design is put on the following: PCPV and support system, reactor steel structures, core structure and restraints, boiler support, charge machine, and secondary shutdown system. British AGR program to date and for the future, and AGR development potential are also explained. (JA)

28647 INTERESTING FUEL FOR THE HTGR. Kasten, P. Oak Ridge Nat. Lab. Rev.; 6: No. 3, 1-6(Fal 1973).

The acceptance of the HTGR as an energy source involves an available economical fuel recycle facility. Development of fuel recycle technology continues at Oak Ridge National Laboratory, Gulf General Atomic, and Idaho Chemical Processing Plant. The HTGR core assembly consists of fueled graphite elements. ThO_2 is coated with Biso coating. The fissile UC_2 is coated with the Triso coating. The coated microspheres are mixed with matrix material containing pitch and graphite filler to form fuel rods about $\frac{5}{8}$ in. in diam and 3 in. long. These rods stack in the graphite moderator block that stands about 31 in. high with 14-in. flats. The recycle element is similar to the initial fuel except the fissile particles consist of Biso-coated kernels of (Th, $^{233}U)O_2$, having a Th/U ratio of about 4. Fuel recycle operations involving crushing irradiated fuel elements and burning the graphite and the particle coatings in a fluidized-bed burner are being developed at GGA where a cold pilot plant is under construction. The hot pilot plant for fuel reprocessing will be constructed at ICPP and the method to be employed for separating fuels and fission products is to be the Acid-Thorex process. Research programs in all stages of the processes are described. The optimum time to initiate fuel recycle considering the time required to develop recycle technology, to design, build, and check out a fuel recycle hot pilot plant, and to operate the pilot plant successfully, is 1980–1981. Then 1985 is the projected date for the operation of a commercial recycle plant. (MCW)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 28743 and 28760.

28648 STATUS OF THE SGHWR SYSTEM. Moore, J.; Hicks, D.; Bradley, N.; Rowlands, I. T. Technical Meeting No. 4/2. Basel; Nuclex (1972). 22p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The SGHWR is a direct cycle boiling light water reactor with a heavy water moderator. Distinguishing features are the use of pressure tubes instead of a large pressure vessel, provision of emergency cooling water as a spray operating directly onto fuel pins and the absence of moving mechanical components in the core. Operation of the 100 MW(e) Winfrith reactor for almost 5 years has shown the system to be reliable and accessible for inspection and maintenance. Dynamic characteristics and fuel and materials performance relevant to current commercial designs have been demonstrated. (auth)

28649 PRINCIPAL OPERATIONS CONNECTED WITH THE RE-STARTUP OF EL-4. Decool, F.; Bitsch, D.; Clara, P.; Cordier, G.; Thome, P. Technical Meeting No. 4/4. Basel; Nuclex (1972). 26p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The Monts d'Arrée Nuclear Power Station (EL-4) stopped its power increase in August 1968 following the failure of the steam generators. During the thirty-month shutdown several innovations were adopted beyond the replacement of these exchangers by ones of new design. Five microleakages were located and repaired on junctions between strength tubes and vessel bottoms. Several com-

ponents were strengthened in the gas circuit. As a result of the importance of the modifications an extensive test program was conducted as if it were a first startup. Since November 15, 1971 EL-4 has been operating satisfactorily at full power and in all conditions, thus justifying the innovations adopted. (auth)

28650 COMMISSIONING AND OPERATING EXPERIENCE WITH THE PICKERING GENERATING STATION. Horton, E. P. Technical Meeting No. 4/5. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Three 500 Mw units of the commercial CANDU Pickering Generating Station have now been brought into operation. Unit 1 has been in operation since April 1971, Unit 2 in October 1971 and Unit 3 in May 1972. Experience in commissioning and operating these units is described. The paper deals with heavy water management, fuel handling and other aspects of operating a large scale, pressurized heavy water reactor. (auth)

28651 TECHNOLOGICAL INNOVATIONS OF THE EL-600 PROJECT. Recent Results. Boiron, P.; Gauzit, M.; Thome, P. Technical Meeting No. 4/6. Basel; Nuclex (1972). 18p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Studies made on the EL-600 project, a pressurized heavy water cooled and moderated reactor, are presented. These emphasize study of the assembly technology and control techniques. (JSR)

28652 ENGINEERING DESIGN FEATURES OF FUGEN. Shima, S.; Akebi, M. Technical Meeting No. 4/7. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

FUGEN is a pressure tube type, heavy water moderated and boiling light water cooled reactor with an output of 165 MW(e). One of the main objects of the FUGEN project is to demonstrate a Plutonium Self-Sustaining Cycle. Engineering design features of major systems of the plant are described. (auth)

28653 ZERO LEAKAGE VALVES FOR HEAVY WATER OPERATION. Parodi, L.; Ghia, G. Technical Meeting No. 4/9. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A type of glandless zero-leakage electromagnetic valve, developed by FIAT Sezione Energia Nucleare, is examined with reference to principle of operation, operating capabilities, size, design and manufacturing criteria, tests, reliability and maintainability. (auth)

28654 DEVELOPMENTS IN CANDU REACTOR OPERATION AND DESIGN. Renshaw, R. H.; Smyth, H. E. Technical Meeting No. 4/1. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The first three 540 MW units at Pickering have provided solid evidence of the suitability of the CANDU reactor for commercial operation. Construction at the 3,000 MW Bruce station is well advanced. The duplication of both these stations is now the subject of a design study. Future development of this pressurized heavy water design is now concentrated on improved reliability and ease of maintenance for large (1200 MW) sizes. Variants of CANDU, using alternative coolants, are being actively developed. The 250 MW boiling light water prototype reactor at Gentilly has performed well in early operation. Experience with organic coolant in a test reactor has been highly successful and has demonstrated the advantage of low activity in the primary circuit. (auth)

28655 FIVE YEARS OF OPERATING EXPERIENCE WITH A 55 MW(e) PHWR (MZFR). Fischer, U. Technical Meeting No. 4/3. Basel; Nuclex (1972). 11p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The MZFR is the first power reactor developed in Germany. Various teething troubles had been overcome by autumn 1969. The availability improved from 86% in 1970 to 98% up to the September 1971 inspection. More than 1700 fuel element changes under load and less than 1% D_2O loss per annum show that the systems are able to satisfy all requirements. (auth)

28656 INTERNAL-PRESSURE CREEP IRRADIATION TESTING APPARATUS FOR Zr-2.5% Nb PRESSURE TUBES. Tsunoda, N. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Doryokuro Giho; No. 6, 55-64 (Dec 1972). (In Japanese).

For the advanced thermal reactor being developed in Japan, heat-treated Zr-2.5% Nb alloy is employed as material for its pressure tubes. To obtain information on the creep characteristics of the pressure tubes for an extended period, an irradiation testing apparatus was constructed. It consists of an irradiation testing section inserted in the core of the JMTR reactor and a control section. The testing section is composed of a Zr-2.5% Nb inner tube and a Zircaloy-2 outer tube. The inner tube, filled with water, is heated electrically, and internal pressure is applied by the saturated steam produced. Creep quantity is obtained by the measurement of inner-tube inside diameter during JMTR operation. (JA)

Power Reactors, Breeding

Refer also to abstracts 27264, 27303, 28732, 28741, and 28759.

28657 (AEC-tr-7489) EXAMINATION OF OXIDE-CLAD REACTIONS IN EXPERIMENT G5 WITH HIGH BURN-UP. Conte; De Keroulas; Mikailoff; Dieumegard. (International Atomic Energy Agency, Vienna (Austria)). 1973. Translation of SM-173/7. (CONF-730726-19). 22p. Dep. NTIS $4.00.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

In order to study the performance of high burn-up oxides and in particular the oxide-clad interactions, a fuel element with a mixed oxide base clad with Type 316 steel, was irradiated with thermal neutrons to a burn-up of 125,000 MWd/ton. This irradiation was carried out in a NaK natural convection device, with which a temperature difference of about 200°C was maintained between the top and the bottom of the fuel element throughout the irradiation. After dismantling the capsule, visual observation and placing the fuel element under internal pressure confirmed the good behavior of the clad. No leak was found. After discussing the characteristics of the fuel element and its irradiation, the principal results obtained are presented. These include: (1) micrographic examination of the mixed oxide structure; (2) study of aspects of the reactions formed on the oxide-clad interface; (3) influence of the temperature inside the clad on the thickness of these reaction zones; and (4) microprobe analysis of the reaction zone constituents on a sample whose temperature inside the clad was 720°C. (auth)

28658 (CEA-CONF-2451) FAST REACTOR PHYSICS IN FRANCE. Bussac, J.; Estavoyer, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1972. 29p. (In French). (CONF-721109-29). Dep. NTIS (U. S. Sales Only) $3.50.

From international conference on nuclear solutions to world energy problems; Washington, District of Columbia, USA (12 Nov 1972).

The reactor physics research program associated with the fast reactor development in France is reviewed. Most of the research was specific to the PHENIX reactor and a 1200 MW(e) demonstration plant. (JWR)

28659 (EURFNR-1149) TRANSPORT PHENOMENA IN MIXED OXIDE FUEL PINS. Bober, M.; Schumacher, G. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Dec 1973. 23p. (KFK-1887). Dep. NTIS (U.S. Sales Only) $4.25.

Work performed under United States-Euratom Fast Reactor Exchange Program.

Transport phenomena occurring in fast reactor mixed oxide fuels and their effect on the fuel pin behavior under irradiation are discussed. In the initial phase, transport of fuel constituents through evaporation-condensation processes and transport of oxygen via the gas phase and solid state thermal diffusion take place. Both processes depend strongly on the O/(U + Pu) ratio. With increasing burnup, redistribution of fuel constituents by thermal diffusion becomes appreciable, which produces a continuously growing effect. Volatile fission products are transported through cracks and interconnected porosity channels toward the inner cladding surfaces. Soluble fission products migrate by thermal diffusion in the matrix and by evaporation condensation processes during healing of cracks. Insoluble solid fission products are moved with migrating pores. Plutonium is transported to the fuel center producing an increase in central temperature of about 100°C in pins with a power rating of 500 W/cm. Oxygen transport processes establish a radial oxygen distribution with a nearly stoichiometric condition in the fuel periphery even for strongly hypostoichiometric mixed oxides. Volatile fission products together with the oxygen at the fuel periphery cause the attack on the cladding. (auth)

28660 (GEAP-4822) STUDIES OF ALTERNATE CORE DESIGN CONCEPTS FOR FAST, SODIUM COOLED REACTORS. Cowan, C. L.; Gyorey, G. L. (General Electric Co., Sunnyvale,

Calif. (USA). Advanced Products Operation). Oct 1966. Contract AT(04-3)-189. 44p. AT.

Studies were carried out to investigate a number of nuclear core design alternatives for a 1000 MW(e) sodium cooled, PuO_2–UO_2 fueled fast breeder reactor. One of the chief objectives was the investigation of core concepts which will meet stringent safety requirements on the sodium loss reactivity effect. Results are presented. (11 references) (auth)

28661 (GEAP-10028-48) CORE ENGINEERING FORTY-EIGHTH QUARTERLY REPORT, AUGUST–OCTOBER 1973. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Nov 1973. Contract AT(04-3)-893. 80p. AT.

Progress is described for tasks related to fuel rods, fuel rod assemblies, core restraint, and control and blanket assemblies. (auth)

28662 (JUL-CONF-9) DEVELOPMENT PROJECT FOR GCFR FUEL ELEMENT IRRADIATIONS IN THE He-LOOP-MOL. Meeting, Juelich, Germany, February 26, 1973. Krug, W. (ed.). (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany)). Jun 1973. 105p. (In German). (CONF-730225-). Dep. NTIS (U.S. Sales Only) $7.25.

A development program is described which deals with the investigation and testing of ventilated GSB fuel element bundles. A survey on the scope, planning and state of irradiation experiments is given. The conference report is a compilation of all 14 lecture manuscripts of the meeting. (GE)

28663 (KFK-1273-3) FAST BREEDER PROJECT. Third Annual Report, 1973. (Kernforschungszentrum Karlsruhe (F.R. Germany). Projekt Schneller Brueter). Dec 1973. 168p. (In German). (EUR-4971). Dep. NTIS (U.S. Sales Only) $11.50.

The main problems in fuel rod technology turn out to be the chemical and mechanical interactions between the fuel and the cladding as well as cladding material swelling. Within the framework of SNR 300 mockups additional measurements are reported concerning the influence of the control rods on the power distribution in the SNEAK-9A-2 assembly. Cross-section measurements performed at the Van-de-Graaff accelerator yielded especially resonance parameters of Co-59. The group set KFK INR was checked by verification of some reactivity values of SNEAK-5C. A two-dimensional removal diffusion shielding program was made available. Simulation experiments carried out at FR2 to study the methods of detection of reactivity disturbances caused by sodium boiling are being analyzed with a view to possible application in SNR 300. Neutron detectors for core monitoring are also tested in FR2, experiments to be performed in KNK are being prepared. Furthermore, measurements in KNK are reported which are related to the influence of the primary coolant throughput on the noise spectra of reactor tank movements and the neutron flux. Preliminary test results are available on the behavior of fiber and sandbed filters with respect to sodium and sodium oxide aerosols, respectively. Intermediate results have been obtained of fluid-dynamic testing of absorber rod bundles. These are, among others, data on sodium throughput in the bundle relative to the total throughput as well as on the point of levitation. It was demonstrated for an air circuit that with respect to fuel elements of gas-cooled breeders hot spots are not to be anticipated below spacers in smooth and in roughened tubes. (auth)

28664 (ORNL-4947) HIGH-TEMPERATURE STRUCTURAL DESIGN METHODS FOR LMFBR COMPONENTS. Progress Report for Period Ending December 31, 1973. Greenstreet, W. L.; Corum, J. M.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 238p. AT.

Activities for the period July through Dec 1973 are reported. The purpose is to develop a verified structural design technology for LMFBR vessels, components, and core structures. Materials properties and behavior, mathematical analogs for materials response, structural analysis, and design criteria are included. Tensile, stress-rupture, and creep properties of Type 304 and 316 stainless steels were measured. (DLC)

28665 (WARD-SS-3045-5) RADIAL BLANKET AND SHIELD SIMULATION EXPERIMENTS. Quarterly Progress Report for Period Ending January 31, 1974. Gibson, G.; Wrights, G. N.; Rittenberger, R. V. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Mar 1974. Contract AT(11-1)-3045. 23p. AT.

The additional rod-drop experiments were performed at ORNL this quarter. These experiments were viewed by an ARD representative. Preliminary analysis of these experiments confirmed that reactivity determination for the ex-vessel detector are consistent with the in-core detector to within 10 percent. Analysis of the first generation fission experiments has been completed. This analysis compared the calculational technique used at ARD with the experimental results obtained at ORNL. The analysis shows that the ARD calculational technique under-predicts the experimental results in this experimental program by as much as a factor of three, but normally within a factor of two. Analysis of these differences are not completely clear, however, contributing factors are: 1) the low order (S_8) angular representation of the source; 2) the use of P_3 transport corrected cross sections; and 3) probable errors in the iron and nickel cross sections in the ABBN library. These discrepancies are to be investigated in design analysis. (auth)

28666 WASH-1102(2nd Ed.)) LMFBR: LIQUID METAL FAST BREEDER REACTOR PROGRAM PLAN. Element 2. Plant Design. (Argonne National Lab., Ill. (USA)). Dec 1973. 215p. Dep. NTIS $7.60.

The Plant Design Element, which is concerned with the development of plant concepts and related plant-design technology, deals most directly with the objective of the program—the development of a technology for LMFBR power plants for the utility environment. The design process develops technical descriptions of plant concepts. This process requires that choices be made. Plant features and parameters are selected; functional requirements are established; technology status is evaluated, and research and development needs are identified. Design trade-off studies are a normal part of this effort—e.g., alternative design features with greater associated risks or increased development requirements versus more conservative features and related lower performance, and improved reliability versus increased costs. In every case, Plant Design is interested in the combination of choices that leads to the best overall plant. (auth)

28667 (WASH-1103(2nd Ed.)) LMFBR: LIQUID METAL FAST BREEDER REACTOR PROGRAM PLAN. Element 3. Plant Systems and Components. (Argonne National Lab., Ill. (USA)). Dec 1973. 392p. Dep. NTIS $10.60.

The objective of the work outlined in the Plant Systems and Components Element of the LMFBR Program Plan is to provide for the first-of-a-kind development of those systems and components necessary for successful commercial LMFBR heat-transport system; auxiliary reactor plant system; component cleaning, inspection, and maintenance facilities; shielding, containment, and reactor service buildings; and energy conversion and power generation. The near-term focus is on the developmental efforts needed for the timely completion of the demonstration-plant program so that the accrued technology along with that obtained from FFTF and other ongoing programs provide a firm basis on which to proceed to commercially viable plants and a true breeder economy. Specific systems included in this Element are the primary and secondary coolant systems (pumps, IHX, valves, and fittings); steam generation system (steam generator, feedwater system, etc.); auxiliary reactor plant systems (liquid-metal receiving and processing, inert-gas receiving and processing, impurity monitoring, sampling and analysis, auxiliary heating and cooling, and radioactive-waste processing); component cleaning, inspection, and maintenance facilities; shielding, containment, and reactor service buildings; and energy conversion and power generation system (generator and switch). (auth)

28668 (WASH-1105(2nd Ed.)) LMFBR: LIQUID METAL FAST BREEDER REACTOR PROGRAM PLAN. Element 5. Sodium Technology. (Argonne National Lab., Ill. (USA)). Dec 1972. 478p. Dep. NTIS $6.00.

The Sodium Technology Element is concerned with the development of a base technology adequate to provide reasonable assurance of LMFBR plant reliability and life. Since the Element is mission oriented, basic understanding is called for only where it is needed to support design and operation of the LMFBR plants. The most significant problem area is that of interactions of cladding and structural materials with sodium and its impurities. Acceptable sodium-impurity limits must be defined and formulated into appropriate system specifications and RDT Standards. Included in the sodium technology program are studies on the behavior and control of fission products in the coolant sodium and on failed fuel monitoring (FFM) systems. For sodium and cover-gas purification systems, on-line monitors and FFM systems, this Element extends beyond base technology and concept development and includes the design, fabrication, proof testing and procurement of components. (auth)

28669 (WASH-1106(2nd Ed.)) LMFBR: LIQUID METAL FAST BREEDER REACTOR PROGRAM PLAN. Element 6. Reactor Systems and Components. (Argonne National Lab., Ill. (USA)). Dec 1972. 337p. Dep. NTIS $6.00.

This Element of the LMFBR Program Plan describes development work needed for the design of the Reactor Heat Generation System and the Core Component Handling System of an LMFBR

power plant, in the near term for demonstration plants and in longer range for safe and reliable target plants capable of competitive operation in electric utility systems. The Reactor Heat Generation System (RHGS) encompasses the reactor vessel and all systems and components therein as required for delivering the rated thermal output of the plant to the interfacing Heat Transport System for breeding new fuel from fertile material, and for "burning" the reactor fuel efficiently. The Core Component Handling System (CCHS) encompasses all systems and components required to transport fuel and related assemblies from the new fuel receiving station to the reactor, and from the reactor to the spent fuel shipping station, including preparation for exposure in the reactor, storage after exposure and preparation for shipment. (auth)

28670 (WASH-1107(2nd Ed.)) LMFBR: LIQUID METAL FAST BREEDER REACTOR PROGRAM PLAN. Element 7. Fuels and Materials. (Argonne National Lab., Ill. (USA)). Dec 1972. 194p. Dep. NTIS $3.00.

Areas of work covered in the Fuels and Materials Element to develop technology for fuels, cladding, fuel elements, control elements, structural materials, and materials for other applications extend from base technology through proof-of-principle. More specifically, the Fuels and Materials Element outlines programs designed to: (1) Determine in- and out-of-reactor properties of materials, with emphasis on the effect of LMFBR conditions; (2) Determine and understand the effect of pertinent variables on the behavior of materials under possible LMFBR conditions; (3) Develop specific materials data as required for design, specification, and procurement; (4) Implement performance tests of materials as required for components under expected LMFBR conditions; (5) Establish performance limits of fuel-element materials under expected LMFBR conditions; (6) Determine the behavior of defective fuel elements; (7) Develop technology and processes for fabrication of fuels and other components, as the needs are identified, to the point of specific applications; (8) Develop and apply nondestructive testing and examination methods; (9) Ensure the availability of adequate procedures for quality assurance and standardization; (10) Stockpile well characterized materials for experimental programs where appropriate. Within each area, emphasis is placed on meeting the requirements that arise because LMFBR conditions are beyond present practical experience. (auth)

28671 (WASH-1108(2nd Ed.)) LFMBR: LIQUID METAL FAST BREEDER REACTOR PROGRAM PLAN. Element 8. Fuel Recycle. (Argonne National Lab., Ill. (USA)). Dec 1972. 232p. Dep. NTIS $3.00.

The Fuel Recycle Element of the Program Plan outlines developments and schedules required for an orderly and efficient demonstration of fuel-recycle technology adequate to facilitate the growth of a viable LMFBR-power industry. The scope of the program for the Fuel Recycle Element is that portion of the fuel cycle between removal of partially spent fuel and blanket material from the reactor site and return to the reactor site of newly fabricated fuel and blanket assemblies. Operations in the fuel cycle include shipping, reprocessing, preparation and fabrication, fuel materials management, and management of wastes. Also included in the Fuel Recycle Elements are the general fuel-cycle studies pertinent to all of the fuel-recycle operations, – e.g., studies of economics, siting criteria for reprocessing plants, safety, fuel accountability, liability risks, safeguards, and government licensing and regulation. Two important responsibilities of the Fuel Recycle programs are the demonstration of commercial fabrication capabilities for initial cores, and the development and demonstration of quality assurance technology to permit industry to fabricate fuel which can meet LMFBR-design objectives. (auth)

28672 (WASH-1109(2nd Ed.)) LMFBR: LIQUID METAL FAST BREEDER REACTOR PROGRAM PLAN. Element 9. Physics. (Argonne National Lab., Ill. (USA)). Dec 1972. 414p. Dep. NTIS $6.00.

The Physics element of the Program includes all applied research and development on differential and integral data and theoretical methods dealing with the interaction of neutrons and gamma rays with all materials in the reactor system. All the applied R&D required to generate nuclear data, and develop techniques and understanding for the nuclear design of Demonstration, Test and Commercial power plants and the establishment of an LMFBR industry are included. Direct design-support activities— such as mockup criticals and neutronic core design—design, construction, and fuel production are also included. Determination of the technical status of, and related confidence in, physics design methods is an integral part of the program evaluation. Evaluation includes surveys, intercomparisons, economic analyses, and correlations between predictions and observations on actual systems. The quantitative correlations will include work to indicate the state of the art at any time. This effort includes maintaining an awareness of related work and coordination with related physics activities being carried out under the sponsorship of other divisions of the AEC, other federal agencies, and foreigh R&D establishments. (auth)

28673 NUCLEAR CHARACTERISTICS OF SANDWICHED-BLANKET TYPE CORE FOR POWER REACTOR. Kobayashi, Y.; Kondo, S.; Togo, Y. (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 11, 700-702(Nov 1973).

28674 NUCLEAR FUEL CYCLE AND ITS ECONOMY. Takei, M. (Japan Energy Economic Research Inst., Tokyo). Genshiryoku Kogyo; 19: No. 6, 33-37(Jun 1973). (In Japanese).

Economic aspects in the evaluation of nuclear fuel cycle cost for fast breeder reactors are discussed, based on the nuclear data obtained by the conceptual designs of 1000 MW(e) and 1500 MW(e) fast breeders. In the first part, burnup characteristics and items of the fuel cycle cost of fast breeders are given together with those of light water reactors. Time for doubling and effective breeding ratio are 13.6 years and 1.29 for the 1500 MW(e) plant and 36.3 years and 1.078 for the 1000 MW(e) plant, respectively. The fuel cycle cost was evaluated by using estimated component cost values in the year 2000; 0.671 mills/kWh, 0.748 mills/kWh and 1.90 mills/kWh for the 1500 MW(e) and 1000 MW(e) fast breeders and light water reactor plant, respectively. Itemized costs for core, axial blanket and radial blanket are also given. Emphasis is placed on the importance of internal breeding ratio and the proper selection of dwell time for radial blanket fuel assemblies. In the second part, the optimization of blanket fuel management is discussed. It is suggested that the uniformity of burnup and the dwell time of radial blanket assemblies will be effective in decreasing the fuel cycle cost, and that the optimum thickness of the radial blanket depends on the relative values of plutonium to other component costs such as fabrication and reprocessing. Finally, as the important but uncertain factors in the fast reactor fuel cycle, price of plutonium and the technical aspects of out-of-core plutonium cycle are pointed out. (JA)

28675 NUCLEAR FUEL ASSEMBLY COMPRISING A SLEEVE OF VARIABLE THICKNESS. Chenal, J. C.; Schaller, K.; Skok, J.; Venobre, H. (to Commissariat a l'Energie Atomique). US Patent 3,795,579. 5 Mar 1974. Priority date 5 May 1971, France. 4p.

The fuel assembly comprises at least one bundle of canned-fuel pins of substantial length which are disposed on a uniform lattice and enclosed within a sleeve through which the coolant flows in a general direction parallel to the fuel pins. The thickness of the sleeve in the downstream portion is smaller than in the upstream portion as considered in the direction of coolant flow. (Official Gazette)

Research, Test, and Experimental Reactors

Refer also to abstracts 28661, 28662, and 28699.

28676 (AAEC/S-15) MATHEMATICIAN'S COMPUTER STUDY OF THE REACTOR MOATA. Summer School. Barry, J. M.; Clancy, B. E.; Gilbert, C. P.; McCulloch, D. B.; Pollard, J. P.; Sanger, P. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan 1974. 121p. Dep. NTIS (U.S. Sales Only) $8.25.

These notes collect together lectures on analysis of time dependent (kinetics) experiments on the reactor MOATA. An introduction is given to scientific problem solving for the kinetics study by the use of mathematics and computers. (auth)

28677 (ANL-7542(Add.B)) CATALOG OF ROD-DROP AND TRANSFER-FUNCTION DATA FROM EBR-II RUNS 47-66. Larson, H. A. (Argonne National Lab., Ill. (USA)). Jan 1974. Contract W-31-109-eng-38. 49p. AT.

Reactivity-perturbation experiments using the rod-drop procedure have been conducted in EBR-II for runs 47-66. Feedback-reactivity data for runs 25-30, as obtained from rod-drop and rod-oscillator tests, were described in ANL-7542; feedback-reactivity data for runs 32-46, as obtained from rod-drop tests, were described in ANL-7542, Addendum A. The present addendum supplements these data with the next series of rod-drop tests. (41 figures) (auth)

28678 (CEA-N-1656) CONCLUSIONS ON COMPARISONS MADE BETWEEN NEUTRONIC MEASUREMENTS AND CALCULATIONS FOR THE RAPSODIE-FORTISSIMO START-UP CORE.

Chavardes, D.; Gourdon, J.; Kremser, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13, Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). Aug 1973. 43p. (In French). Dep. NTIS (U.S. Sales Only) $5.25.

Comparisons made between experiments and calculations on the neutronics of the core of the Fortissimo version of Rapsodie (1970) are presented. The following topics are considered: reactivities, reaction rates (^{235}U, ^{238}U, and ^{239}Pu); power distributions; maximum linear power. The calculations take into consideration the real compositions. They are made using cylindrical and hexagonal geometries and are based on the Cadarache version 2 set of cross sections. The measurements were obtained by the irradiation of fissile detectors. (FR)

28679 (HEDL-TME-71-29(Vol.1)) WADCO QUARTERLY TECHNICAL REPORT, OCTOBER–DECEMBER 1970. Volume I. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Mar 1971. Contract AT(45-1)-2170. 44p. AT.

Information is presented concerning FFTF construction and FFTF component specifications and development. (DCC)

28680 (HEDL-TME-71-29(Vol.2)) WADCO QUARTERLY TECHNICAL REPORT, OCTOBER–DECEMBER 1970. Volume II. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Mar 1971. Contract AT(45-1)-2170. 92p. AT.

Information is presented concerning the reactor technology and measurements and control development programs for the FFTF. Topics discussed include: physics; thermal and hydraulic development; mechanical development; physical measurements technology; control and data systems; and nondestructive testing development. (DCC)

28681 (HEDL-TME-71-29(Vol.3)) WADCO QUARTERLY TECHNICAL REPORT, OCTOBER–DECEMBER 1970. Volume III. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Mar 1971. Contract AT(45-1)-2170. 106p. AT.

Information is presented concerning sodium technology and chemical process technology development for the FFTF. Topics discussed include: fuel failure location development; sodium removal and materials requalification; sodium purification; radiation and repair engineering; laboratory sodium analysis; cover gas systems; engineering support to large sodium systems; radiation exposure control; processing of discharged fuel; and microstructural analysis. (DCC)

28682 (PWAC-283) HAZARDS SUMMARY REPORT ON CRITICAL EXPERIMENT PROGRAM NO. 2 AT CANEL, OCTOBER 1958. Richings, H. J.; Kennedy, W. G.; Sandin, E. V.; Crume, E. C. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 15 Dec 1959. Contract AT(11-1)-229. 143p. Dep. NTIS $10.25.

Declassified 20 Sep 1973.

The critical experiment program performed at CANEL on the moderated lithium-cooled solid fuel reactor is described. Hazards related to this particular series of critical experiments are discussed. The operation of the experimental assembly is described. Safety features of the building, equipment and operations are pointed out. Possible accidents and the resulting hazards to surrounding areas are analyzed. (auth)

28683 (PWAC-309) HAZARDS SUMMARY REPORT ON CRITICAL EXPERIMENT PROGRAM NO. 4 AT CANEL. Fader, W. J.; Kennedy, W. G.; Sandin, E. V.; Krause, J.; Crume, E. C. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Dec 1960. Contract AT(11-1)-229. 160p. . Dep. NTIS $10.00.

Declassified 20 Sep 1973.

The critical experiment program to be performed at the CANEL Nuclear Physics Laboratory on the uranium monocarbide fueled reactor is presented for consideration and approval by the Division of Licensing and Regulation and the Advisory Committee on Reactor Safeguards. Necessary considerations are presented to permit an evaluation of the hazards of this particular series of critical experiments. Information is given on the nature and operation of the experimental assembly. Safety features of the building, equipment and operation are pointed out. Possible accidents and the resulting hazards to surrounding areas are analyzed. Details of the surrounding area are described with supporting reports as appendices. (auth)

28684 (RT/BIO-(73)32) EVALUATION OF NEUTRON FLUXES AND GAMMA-RAYS DOSE IN THE VERTICAL CHANNELS OF THE SOURCE FAST REACTOR TAPIRO FOR RADIOBIOLOGICAL STUDIES. Palamidessi, A.; Lori, A.; Di Paola, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 9 Oct 1973. 39p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.00.

In relation to a research program on the biological effects of neutrons, two vertical channels were arranged in the fast reactor Tapiro of the Casaccia Nuclear Research Center for irradiation of small mammals and biological materials in vitro. For the design of the protective shield and in the light of the future dose measurements in situ, a calculation of neutron fluxes and gamma-rays/dose along the length and at the outlet of the channels has been performed. (auth)

28685 (RT/FI-(73)34) BURN-UP CALCULATIONS FOR VVR-S LATTICE CELL. Cepraga, D. G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 27 Nov 1973. 27p. Dep. NTIS (U. S. Sales Only) $4.50.

Microscopic burnup calculations were performed for the VVR-S lattice cell using the THERMOS and RIBOT computer codes. The significance of the results is discussed. (JWR)

28686 (SLA-73-8021) LOCAL, ZERO-POWER VOID COEFFICIENT MEASUREMENTS IN THE ACPR. Rivard, J. B.; Thome, F. V. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 9p. (CONF-740206-1). Dep. NTIS $3.00.

From Triga owner's conference; Albuquerque, New Mexico, USA (25 Feb 1974).

Changes in reactivity may be stimulated in the ACPR by the local introduction of voids into the reactor coolant. The local void coefficients of reactivity which describe this effect are of interest from a reactor safety point of view, and their determination is described. Bottled nitrogen gas was used to produce the voids. The gas was forced out of a small diameter tube which was positioned vertically in the core lattice with its open end below the fuel. The gas was passed through a pressure regulator, a valve, and a flowmeter to establish a steady flow condition, following which a delayed-critical (zero-power) reactor state was established. Correlation of the average volume of core void created by the nitrogen flow with the reactivity worth of the delayed-critical control-rod bank position produced the values of the zero-power void coefficients of reactivity. The void coefficients were determined at various core positions from ~6 mm to 142 mm beyond the central irradiation space and for three different flow rates. For the range of void fractions investigated, these coefficients are negative, with values ranging between –$0.02 and –$0.12. Tabular and graphical results of the measurements are presented, and details of the coefficient determination are explained. (auth)

28687 CRITICAL FACILITY OF KYOTO UNIVERSITY REACTOR. Shibata, T. (Kyoto Univ., Osaka); Kanda, K.; Yamamoto, M. Genshiryoku Kogyo; 19: No. 4, 40-45(Apr 1973). (In Japanese).

The critical facility for common use among universities is intended to have basic characteristics. Its core structure should be easily rearranged for effective use. It should enable the basic researches for high performance research reactor, breeding cycle of thorium and state of criticality. By using this critical facility, the following research themes are scheduled: research of critical mass and distribution of neutron flux, research on reactor safety, basic research of high neutron flux reaxtors, basic study on thorium cycle, research on fast neutron system inside test zone, and research on other relevant themes. Three stands, on which cores are mounted, are prepared. Control system is provided for one nuclear reactor. The other stands than that in operation are constructed so as to never reach criticality. Safety protection equipment is installed to prevent accidents, even if careless operation is performed. Two core stands are prepared for solid moderating assemblies and one for a light water moderating assembly. Fuel is 93% enriched uranium-aluminium alloy. The power output of each assembly is 100 watts. (JA)

Production and Materials Testing and Processing Reactors

28688 (CEA-CONF-2457) MINI REACTOR FOR NEUTRON RADIOGRAPHY. Houeelle, M.; Mercier, C.; Revol, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). [nd]. 22p. (CONF-730981-1). Dep. NTIS (U. S. Sales Only) $3.25.

From conference on radiography with neutrons; Birmingham, UK (10 Sep 1973).

A small pulsed reactor which produces bursts of neutrons for neutron radiography is described. The reactor consists of a 30 cm diameter cylindrical stainless steel core containing a uranyl nitrate solution with fixed lateral reflector and movable bottom reflector. Bursts of neutrons are generated when the core is rendered momentarily supercritical on inward movement of the lower reflector, then shuts itself down by inherent negative reac-

tivity coefficients. The chain reaction is stopped completely by bringing the reflector back to its initial position. The mini-reactor is surrounded by a concrete biological shield through which the neutron collimators are built. Characteristics and performances of the reactor are given. Examples of neutron radiographs of various objects and irradiated fast-reactor fuel are presented. (auth)

28689 (DUN-7436) N REACTOR SCRAM OF SEPTEMBER 30, 1970. Coleman, G. C. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 12 Jan 1971. Contract AT(45-1)-1857. 20p. Dep. NTIS $3.00.

During the early phases of startup and power ascension activities on September 30, 1970, the Hanford N Reactor received an automatic shutdown (scram) signal from its safety system which monitors reactor coolant flow. The reactor neutron absorbing safety rod system, which should normally function to achieve reactor shutdown, failed to automatically respond to the scram signal and insert all withdrawn rods into the reactor core. Failure of the neutron poison rods to automatically insert caused the automatic automatic activation of the reactor safety backup shutdown system which achieved an immediate and safe shutdown of the reactor. The investigations, findings, and corrective actions taken as a result of the September 30 scram of the N Reactor are discussed. Failure of the rod system to respond to the scram signal was conclusively determined to have been the result of a "sneak" circuit permitted by the shorting failure of multiple in-series diodes specifically designed into the rod control circuitry to prevent this type of sneak circuit. It was also clearly established that at no time was the reactor in or near an unsafe condition. (auth)

Propulsion and Package Reactors

Refer also to abstracts 26791, 27187, 27189, 27387–27389, 28682, and 28758.

28690 (APEX-901) COMPREHENSIVE TECHNICAL REPORT. General Electric Direct-Air-Cycle, Aircraft Nuclear Propulsion Program. Program Summary and References. Thornton, G.; Rothstein, A. J.; Culver, D. H. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 28 Jun 1962. Contract AT(11-1)-171. 302p. Dep. NTIS $17.25.

Declassified 12 Sep 1973.

The background to the General Electric program is discussed, and the various direct-air-cycle nuclear test assemblies and power plants that were developed are summarized. Because of the requirements of high performance, low weight, and small size, vast improvements in existing technology were required to meet the flight objectives. The technological progress achieved during the program is also summarized. (auth)

28691 (CNLM-5671) CONCEPTUAL DESIGN STUDY OF A POWERPLANT FOR A DEEP OPERATING SUBMERSIBLE. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 2 Jul 1964. Contract AT(30-1)-2789. 288p. Dep. NTIS $17.50.

Declassified 5 Sep 1973.

The Advanced Sea Based Deterrent (ASBD) Committee has expressed an interest in power plants of 1400 to 25,000 hp rating for potential use in submersible vehicles with 8000 feet or greater operating depth. The conceptual design of a power plant for such a deep operating submersible (DOS) at the upper end of the power range of interest is presented in detail. The design is based on CANEL's lithium-columbium reactor technology and Pratt & Whitney Aircraft's proven gas turbine technology. Weight and performance data for similar power plants covering the entire power range are also presented. Cost and reliability forecasts for the large power plant are presented to assist an evaluation of its cost effectiveness. Potential improvements in the power plant concept which should be investigated in a continuing design study are discussed. (auth)

28692 (CNLM-6249) COMPARISON OF SNAP-50/SPUR SYSTEM WITH MHD, BRAYTON, BOILING REACTOR AND THERMIONIC SYSTEMS. Allen, J. E. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 27 Apr 1965. Contract AT(30-1)-2789. 30p. Dep. NTIS $3.50.

Declassified 31 Aug 1973.

The SNAP-50/SPUR system is compared with a boiling potassium reactor, in- and out-of-pile thermionic reactors, MHD systems, and a Brayton cycle gas cooled reactor. Particular emphasis is on specific weight, maximum operating temperatures, and cycle efficiency. The performance characteristics and advantages and disadvantages of each type of system are discussed. (JWR)

28693 (CNLM-6343) A 1.2 MW(e) POWERPLANT DESIGN. Chalfant, A. I. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 15 Jul 1965. Contract AT(30-1)-2789. 30p. Dep. NTIS $3.50.

Declassified 31 Aug 1973.

A 1.2 MW(e) SNAP-50/SPUR power plant using four 300 kW (e) power conversion modules is described. The power plant may be used for either manned or unmanned space missions requiring large amounts of electric power. The design of the shield package is discussed in detail. (JWR)

28694 (DC-59-2-1) ALTERNATE XMA-1 POWER PLANT STUDY. Mitchell, T. R. (General Electric Co., Cincinnati, Ohio (USA). Aircraft Nuclear Propulsion Dept.). Mar 1959. 129p. Dep. NTIS $8.50.

Declassified 13 Sep 1973.

The results are presented of single-engine power plant studies which were performed to obtain comparisons among the different types of single-engine power plants and the XMA-1C power plant from the standpoint of performance (thrust/weight ratio), frontal area, and ease of development, maintenance and remote handling. The single-engine power plant designs were developed using the same materials, design criteria and technology which were employed in the design of the twin-engine XMA-1C power plant. Power plant design layouts, weights, thrusts,and frontal areas are presented, as well as a summary of the effect of the various power plants on aircraft performance. (auth)

28695 (GEMP-593) DESIGN OF FAST FLUX TEST FACILITIES FOR 710 FUEL ELEMENTS BASED ON A NEUTRON FILTER. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 31 May 1968. Contract AT(40-1)-2847. 66p. Dep. NTIS $6.50.

Declassified 6 Sep 1973.

The preliminary design of the in-pile portion of a proposed fast-flux, dynamic test facility for 710 Reactor fuel elements in the Engineering Test Reactor at the National Reactor Testing Station is presented. The fast flux environment would be obtained by use of a neutron filter. Results of a study to determine the possibility of a static, fast-flux test facility in the Oak Ridge Reactor are also reported. (auth)

28696 (GEMP-600(Vol. 1)) 710 HIGH-TEMPERATURE GAS REACTOR PROGRAM SUMMARY REPORT. Volume I. Summary. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 1967. Contract AT(40-1)-2847). 94p. Dep. NTIS $7.75.

Declassified 6 Sep 1973.

A description of the 710 Reactor concept and its significant design features is presented. A summary of the history of the 710 Program and a summary of the major technical achievements of the program are included. (13 references) (auth)

28697 (PWAC-271) LITHIUM–COLUMBIUM, SOLID FUEL ELEMENT, FAST REACTOR. Engineering Summary Report. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 7 Aug 1959. Contract AT(11-1)-229. 270p. Dep. NTIS $16.50.

Declassified 20 Sep 1973.

The engineering design study of a proposed aircraft reactor, PWAR-12, and its low power test reactor version, PWAR-12C, is described. Information is presented concerning engineering design, reactor physics, test operation, and materials of design. (DCC)

28698 (PWAC-313) CCA-3 CRITICAL EXPERIMENT PROGRAM REPORT. Fader, W. J.; Krause, J.; Cavanaugh, L. A. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Jun 1961. Contract AT(11-1)-229. 213p. Dep. NTIS $12.75.

Declassified 20 Sep 1973.

Engineering design studies were made at CANEL of a proposed 250 MW aircraft reactor, PWAR-12, a lithium-cooled fast reactor with columbium-clad columbium–uranium dioxide cermet fuel elements, and of a 10 MW test reactor version, PWAR-12C. In support of the design studies, a series of critical experiments were undertaken at the CANEL Nuclear Physics Laboratory on CANEL Critical Assembly No. 3 (CCA-3) to investigate the physics characteristics of the PWAR-12 reactors. A brief description of the PWAR-12 reference design is presented. Descriptions of the critical assembly equipment and instrumentation are included. The experimental results are summarized. (auth)

28699 (PWAC-314) PRELIMINARY HAZARDS REPORT FOR A REACTOR EXPERIMENT AT CANEL, JULY 1959. Bigelow, C. C.; Hedden, D. T.; Crume, E. C. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 20 Jan 1961. Contract AT(11-1)-229. 396p. Dep. NTIS $23.00.

Declassified 20 Sep 1973.

The various hazards that might be associated with the testing of a 10 MW lithium-cooled reactor experiment in the NTF are analyzed. The manner in which these hazards have been considered and evaluated is presented. Prior to startup and test, a final hazards report will be issued covering the final details of construction, control and operation of the reactor and the "as built" facility. The NTF provides the capability for assembly, nuclear testing and disassembly of the 10 MW lithium-cooled reactor experiment. It provides positive containment of all the fission products which might be released from the reactor core as a result of the maximum credible nuclear accident. (auth)

28700 (PWAC-333) FINAL DESIGN AND DEVELOPMENT REPORT OF THE PWAR-11C REACTOR EXPERIMENT. Bauer, H. E.; Bronke, V. W. (comps.). (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Jun 1961. Contract AT(11-1)-229. 302p. Dep. NTIS $17.25.

Declassified 20 Sep 1973.

The results of the engineering design and development of a 10 MW lithium-cooled columbium–zirconium alloy reactor for aircraft propulsion are reviewed. (auth)

28701 (PWAC-370) PRELIMINARY SAFETY ANALYSIS REPORT FOR THE LITHIUM COOLED REACTOR EXPERIMENT (LCRE). Kennedy, W. G.; Crume, E. C. Jr. (eds.). (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 20 Jul 1962. Contract AT(30-1)-2789. 314p. Dep. NTIS $18.75.

Declassified 4 Sep 1973.

Information is presented concerning the LCRE reactor test system; test facilities; operational procedures; safety evaluation; and site characteristics. (DCC)

28702 (PWAC-391) SNAP-50 SYSTEM OPTIMIZATION STUDIES. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1 Mar 1963. Contract AT(30-1)-2789. 107p. Dep. NTIS $7.50.

Declassified 4 Sep 1973.

The results of the latest system optimization studies of the SNAP-50 powerplant are presented. Component parametric data from various groups at CANEL and Pratt & Whitney Aircraft, East Hartford were integrated into an overall study of a nominal 1 MW(e) powerplant. The development of an 8 MW(t) reactor and primary system together with a 300 kW(e) power conversion unit is described. The reactor and primary system can be used with various numbers of power conversion units to provide a family of powerplants covering the range from a single 300 kW(e) power conversion unit operating at derated conditions to four 300 kW(e) power conversion units producing a net electrical power output of 1200 kW(e). The study was divided into individual analyses of the primary loop, the electrical power generation system, the power conversion loop, and the radiator loops. Alternate turbines and radiator systems using direct condensing and NaK radiators were studied. Several alternate methods of providing auxiliary cooling were studied with a preferred method utilizing a separate potassium circuit being selected. The results of the individual analyses were considered in arriving at the flow schematic shown. (auth)

28703 (PWAC-402(Pt.4)) LCRE NON-NUCLEAR SYSTEMS TEST, FINAL REPORT. Overman, A. Y. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). Oct 1965. Contract AT(30-1)-2789. 373p. Dep. NTIS $20.75.

Declassified 12 Sep 1973.

A 5000-kilowatt, 2000°F, lithium-columbium system, which simulated the heat transport loops of a nuclear power plant, was operated successfully for 14 months (10,001 hours) and shutdown routinely. Post-test examination of the components showed them to be in excellent condition except for self-welding within the Li-to-Li exchanger, and trace seepage through a pipe connecting the exchangers. The trace seepage was not unexpected considering the state of fabrication technology at the time it was built. While self-welding did occur, there were no failures induced by it. (auth)

28704 (PWAC-404) LCRE CRITICAL EXPERIMENTS. Paradis, E. L.; Callen, R. C.; Welsh, W. F.; Miller, D. A. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 19 Mar 1964. Contract AT(30-1)-2789. 228p. Dep. NTIS $14.50.

Declassified 5 Sep 1973.

Two series of critical experiments on CANEL Critical Assemblies 5 (CCA-5) and 6 (CCA-6) were undertaken to obtain reactor physics data to substantiate the nuclear analysis of compact, high temperature UO_2-BeO fueled reactors based on lithium-columbium technology developed at CANEL. The CCA-5 experiments consisted of a parametric study, including a range of reactor configurations related to the design of a Lithium Cooled Reactor Experiment. The CCA-6 experiments were a more detailed study of the reactor physics of the proposed LCRE. Tests results are included. (auth)

28705 (PWAC-469) REFERENCE MOTOR DESIGN SNAP-50/SPUR PUMP MOTOR DEVELOPMENT PROGRAM. Allen, T. C.; Madson, R. R.; Neff, W. S.; Yates, W. W. (Westinghouse Electric Corp., Lima, Ohio (USA). Aerospace Electrical Div.). 3 Sep 1965. 150p. Dep. NTIS $10.50.

Declassified 31 Aug 1973.

An initial basic design is described for a high temperature liquid-metal-cooled motor for incorporation into the centrifugal pumps for the SNAP-50 power plant. Included is a detailed technical discussion of the design philosophy, approach, and techniques used to develop the design. This liquid-metal-cooled motor is basically a 3-phase, 400-cycle, strap-wound, squirrel cage rotor, induction motor. The stator and rotor electromagnetic components are protected from the effects of contact with alkali metal in the liquid or vapor form by means of hermetically sealed assemblies which incorporate a ceramic bore seal for the stator and a refractory metal cladding system around the rotor. (11 references) (auth)

28706 (PWAC-594) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT, OCTOBER 1, 1959–DECEMBER 31, 1959. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 31 Jan 1960. Contract AT(11-1)-229. 142p. Dep. NTIS $9.25.

Declassified 20 Sep 1973.

Research progress on the aircraft nuclear propulsion program during the fourth quarter of 1959 is reported. The work included reactor engineering and design, fuel element development, component development, controls and instrumentation development, materials research and development, and power plant performance and airplane evaluation. (JWR)

28707 (PWAC-601) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT, January 1, 1960–March 31, 1960. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 29 Apr 1960. Contract AT(11-1)-229. 169p. Dep. NTIS $11.50.

Declassified 20 Sep 1973.

The results are presented of solid fuel reactor engineering and design including work on a 10 MW reactor experiment and advanced reactor design and cycle studies, the development of reactor and propulsion system components, research work on materials, and analysis work on power-plant performance. (auth)

28708 (PWAC-602) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT, APRIL 1, 1960–JUNE 30, 1960. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 29 Jul 1960. Contract AT(11-1)-229. 145p. Dep. NTIS $9.25.

Declassified 20 Sep 1973.

The results are presented of solid fuel reactor engineering and design including work on a 10 MW reactor experiment and advanced reactor design and cycle studies, the development of reactor and propulsion system components, research work on materials, and analysis work on power plant performance. (auth)

28709 (PWAC-603) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT, JULY 1, 1960–September 30, 1960. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 31 Oct 1960. Contract AT(11-1)-229. 160p. Dep. NTIS $10.00.

Declassified 20 Sep 1973.

The engineering design and development of reactors and powerplant components suitable for advanced aircraft propulsion systems are described. The results are presented of solid fuel reactor engineering and design including work on a 10 MW reactor experiment and advanced reactor design and cycle studies, the development of reactor and propulsion system components, research work on materials, and analysis work on power-plant performance. (auth)

28710 (PWAC-604) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT, October 1, 1960–December 31, 1960. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 31 Jan 1960. Contract AT(11-1)-229. 186p. Dep. NTIS $11.50.

Declassified 20 Sep 1973.

The results are presented of solid fuel reactor engineering and design including work on a 10 MW reactor experiment and advanced reactor design and cycle studies, the development of reactor and propulsion system components, research work on materials, and analysis work on power-plant performance. (auth)

28711 (PWAC-611) NUCLEAR PROPULSION PROGRAM ENGINEERING PROGRESS REPORT, JANUARY 1, 1961—MARCH 31, 1961. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 28 Apr 1961. Contract AT(11-1)-229. 126p. Dep. NTIS $8.50.
Declassified 20 Sep 1973.
The results are presented of solid fuel reactor engineering and design including work on a 10 MW reactor experiment and advanced reactor design and cycle studies. (auth)

28712 (PWAC-612(Vol.1)) REACTOR PROGRAM ENGINEERING PROGRESS REPORT, MAY 1, 1961–JUNE 30, 1961. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 31 Oct 1961. Contract AT(3-1)-2789. 104p. Dep. NTIS $7.25.
Declassified 20 Sep 1973.
The engineering design and development of a high performance, lithium-cooled, reactor experiment including the reactor heat rejection system and test facility are described. (auth)

28713 (PWAC-613(Vol.1)) REACTOR PROGRAM ENGINEERING PROGRESS REPORT, JULY 1, 1961–September 30, 1961. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 31 Oct 1961. Contract AT(30-1)-2789. 94p. Dep. NTIS $6.75.
Declassified 20 Sep 1973.
The engineering design and development of a high performance, lithium-cooled, reactor experiment including the reactor heat rejection system and test facility are described. (auth)

28714 (PWAC-614(Vol.1)) REACTOR PROGRAM ENGINEERING PROGRESS REPORT, OCTOBER 1, 1961–DECEMBER 31, 1961. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 26 Jan 1962. Contract AT(30-1)-2789. 119p. Dep. NTIS $8.00.
Declassified 20 Sep 1973.
The engineering design and development of a high performance, lithium-cooled, reactor experiment including the reactor heat rejection system and test facility are described. (auth)

28715 (PWAC-621) REACTOR PROGRAM ENGINEERING PROGRESS REPORT, JANUARY 1, 1962–March 31, 1962. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Apr 1962. Contract AT(30-1)-2789. 122p. Dep. NTIS $9.25.
Declassified 20 Sep 1973.
The engineering design and development of a high performance, lithium-cooled, reactor experiment including the reactor heat rejection system and test facility are described. (auth)

28716 (PWAC-634) SNAP-50/SPUR PROGRAM ENGINEERING PROGRESS REPORT, OCTOBER 1, 1963–DECEMBER 31, 1963. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 28 Feb 1964. Contract AT(30-1)-2789. 261p. Dep. NTIS $15.25.
Declassified 6 Sep 1973.
A design study of the integration of the SNAP-50/SPUR power plant with a space craft for use with the Titan 111C launch vehicle was completed. Reference Reactor Design No. 2 (8 Mwt) was integrated into the SNAP-50/SPUR power plant design. Emphasis has been shifted to Reference Reactor Design No. 3 (2 Mwt) which is based on a maximum fuel temperature of 2300F and a maximum fuel burnup of 1.5 percent. Environmental tests of control drive components were continued utilizing residual LCRE material. Test temperatures were increased to those of interest for SNAP-50/SPUR. The four-inch pressure vessels completed 9139 and 7896 hours of their scheduled 10,000 hour tests. The full-scale LCRE prototype vessel completed 4800 hours of a 10,000 hour test. A pressure vessel test program was initiated for SNAP-50/SPUR designs using ten-inch vessels. Data on potential SNAP-50/SPUR fuels indicate that serious limitations may exist at design conditions associated with Reference Design No. 2 (8 Mwt). Modifications to the fuel testing program were made to provide an evaluation of fuels at conditions corresponding to those used for Reference Reactor Design No. 3 (2 Mwt). Design was continued on the power plant pumps and drive motors. A preliminary dynamic analysis of the SNAP-50/SPUR power plant was completed on the CANEL electric analog computer. Testing of the Haynes-25 alloy boiling heat transfer loop was continued to 3600 hours at which time a loop failure terminated the test program. The stainless steel boiling potassium loop was discontinued after 2265 hours of operation due to a failure in the boiler. The Non-Nuclear Systems Test was interrupted at 4021 hours by a water leak in the electrical heater cooling circuit. The materials program was continued in support of the SNAP-50/SPUR development effort. A natural convection potassium loop has completed 1655 hours of testing in a vacuum environment. (auth)

28717 (PWAC-641) SNAP-50/SPUR PROGRAM ENGINEERING PROGRESS REPORT, JANUARY 1, 1964–MARCH 31, 1964. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 6 May 1964. Contract AT(30-1)-2789. 267p. Dep. NTIS $15.50.
Declassified 6 Sep 1973.
Research progress in the SNAP-50/SPUR program during the first quarter of 1964 is reported. The work included system integration and applications studies, reactor and shield design and development, boiler design and development, pump design and development, valve and accumulator design and development, major systems tests, materials testing and development, and system controls and instrumentation development. (JWR)

28718 (PWAC-642) SNAP-50/SPUR PROGRAM ENGINEERING PROGRESS REPORT, APRIL 1, 1964–JUNE 30, 1964. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Jul 1964. Contract AT(30-1)-2789. 262p. Dep. NTIS $15.25.
Declassified 5 Sep 1973.
Research progress on the SNAP-50/SPUR program during the second quarter of 1964 is reported. The work included system integration and application studies, reactor and shield design and development, boiler design and development, pump design and development, valve and accumulator design and development, major systems tests, materials studies, and system controls and instrumentation development. (JWR)

28719 (PWAC-643) SNAP-50/SPUR PROGRAM ENGINEERING PROGRESS REPORT, JULY 1, 1964–SEPTEMBER 30, 1964. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 4 Nov 1964. Contract AT(30-1)-2789. 213p. Dep. NTIS $12.75.
Declassified 20 Sep 1973.
Research progress on the SNAP-50/SPUR program during the third quarter of 1964 is reported. The work included system integration and application studies, reactor and shield design and development, boiler design and development, pump design and development, valve and accumulator design and development, major systems tests, materials studies, and system controls and instrumentation development. (JWR)

28720 (PWAC-644) SNAP-50/SPUR PROGRAM ENGINEERING PROGRESS REPORT, OCTOBER 1, 1964–DECEMBER 31, 1964. (Pratt and Whitney Aricraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 5 Feb 1965. Contract AT(30-1)-2789. 255p. Dep. NTIS $14.75.
Declassified 5 Sep 1973.
Research progress on the SNAP-50/SPUR program during the last quarter of 1964 is reported. The work included system integration and application studies, reactor and shield design and development, boiler design and development, pump design and development, valve and accumulator design and development, major systems tests, materials studies, and system controls and instrumentation development. (JWR)

28721 (PWAC-651) SNAP-50/SPUR PROGRAM ENGINEERING PROGRESS REPORT, JANUARY 1, 1965–MARCH 31, 1965. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 14 May 1965. Contract AT(30-1)-2789. 208p. Dep. NTIS $12.50.
Declassified 4 Sep 1973.
Research progress on the SNAP-50/SPUR program during the first quarter of 1965 is reported. The work included system integration and application studies, reactor and shield design and development, boiler and condenser development, pump design and development, valve and accumulator design and development, major systems tests, materials studies, and system controls and instrumentation development. (JWR)

28722 (PWAC-652) SNAP-50/SPUR PROGRAM ENGINEERING PROGRESS REPORT, APRIL 1, 1965–JUNE 31, 1965. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 25 Aug 1965. Contract AT(30-1)-2789. 270p. Dep. NTIS $15.50.
Declassified 20 Sep 1973.
Research progress on the SNAP-50/SPUR power plant development program during the second quarter of 1965 is reported. The work included system integration and application studies, reactor and shield design and development, boiler and condenser fabrication, pump design and development, valve and accumulator design and development, major systems tests, materials studies, system controls and instrumentation development, and studies at the ANL high temperature boiling sodium loop. (JWR)

28723 (TIM-863) SUMMARY OF DESIGN STUDIES LEADING TO PRELIMINARY DESIGN OF 2-MWt REACTOR AND

SHIELD (PWAR-20). Zeisser, M. H. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1 Dec 1964. Contract AT(30-1)-2789. 68p. Dep. NTIS $5.50.

Declassified 30 Aug 1973.

The present SNAP-50/SPUR power plant development program concentrates on a system designed for unattended operation in space for 10,000 hours which produces a net electrical output of 300 kW(e). The reactor and shield for this power plant have been designated as the PWAR-20. The purpose of the design studies conducted since 1962 which led to the present reactor and shield concept are reviewed. (auth)

28724 (TIM-865) PWAR-20 REACTOR (2-MWt) PRELIMINARY DESIGN ENGINEERING ANALYSIS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1 Dec 1964. Contract AT(30-1)-2789. 61p. Dep. NTIS $5.25.

Declassified 20 Aug 1973.

The present SNAP-50/SPUR power plant development program concentrates on a system designed for unattended operation in space for 10,000 hours which produces a net electrical output of 300 kW(e). The reactor and shield for this power plant have been designated as the PWAR-20. The results of engineering analysis conducted to date in support of the PWAR-20 are summarized. (auth)

28725 (TIM-876) DESIGN STUDY OF A 10-MWt REACTOR FOR SPACE APPLICATIONS. Zeisser, M. H. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 18 May 1965. Contract AT(30-1)-2789. 67p. Dep. NTIS $5.50.

Declassified 31 Aug 1973.

The 10.0-MW(t) reactor-shield concept is described. The reactor is lithium-cooled and will have a fast neutron energy spectrum. It is designed to produce 10-MW(t) power for 10,000 hours with a coolant outlet temperature of 2000F using a high density UN fuel system limited by design to 1.5 a/o uranium burnup, columbium alloys for pressure vessel, core support structure and fuel element cladding, and titanium alloys for that portion of the support structure which operates below 1000F. The reactor proportions were selected from the results of the 2 to 40-MW(t) radiatively-cooled reactor parametric studies and are based on the design fuel burnup limit, a maximum fuel temperature of 2300F, and the use of a radially power flattened core. The reactor concept is identical to that of the PWAR-20 reactor except that a safety rod is incorporated in the center of the core to increase the nuclear safety of the reactor during assembly and ground handling. The safety rod is ejected in orbit prior to nuclear startup. 13 references. (auth)

28726 (TIM-954) PRATT AND WHITNEY AIRCRAFT FUEL IRRADIATION TEST VEHICLES. Ackermann, W.; Nelson, C. R. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). Oct 1965. Contract AT(30-1)-2789. 34p. Dep. NTIS $3.75.

Declassified 31 Aug 1973.

The design, fabrication, and experimental efforts expended to develop the in-pile capsule to irradiate fuel candidates for the SNAP 50/SPUR reactor are described. Advanced capsule design concepts that were being considered at the time of contract termination are also described. (auth)

28727 (WANL-TME-1315) NERVA II REACTOR CONCEPTUAL DESIGN REPORT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1965. Contract SNP-1. 173p. Dep. NTIS $10.75.

Declassified 4 Sep 1973.

Presented is a description of the conceptual design of the advanced NERVA reactor. This has resulted from evaluation of work extending from earlier studies reported in WANL-TME-978, "Preliminary Study at the NERVA II Reactor Design" and WANL-TME-1200, "NERVA II Reactor Design Evaluations." As a result of these study evaluations, it is now possible to define a conceptual design for the NERVA II reactor and indicate preliminary system performance. (auth)

28728 (WANL-TNR-202) NRX-A3 REACTOR FINAL TEST REPORT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 Dec 1965. Contract SNP-1. 603p. Dep. NTIS $32.25.

Declassified 4 Sep 1973.

Test analysis of the NRX-A3 test series is presented. Information is presented concerning nuclear analysis, thermal-fluid analysis of flow tests, thermal-fluid analysis of power tests, thermal analysis of medium power mapping and fixed drum test, dosimetry, post-operative radiochemistry, and corrosion analysis. (DCC)

28729 (XDC-60-2-2) ADVANCED CONFIGURATION STUDY POWER PLANT DESCRIPTION AND COMPARISON. (General Electric Co., Cincinnati, Ohio (USA). Aircraft Nuclear Propulsion Dept.). 29 Feb 1960. Contract AT(11-1)-171. 83p. Dep. NTIS $6.25.

Declassified 20 Sep 1973.

A comparative evaluation of the three basic nuclear powered turbojet configurations is presented. Performance, weight, operational characteristics, costs, areas requiring development, and growth potential are analyzed. (DCC)

28730 (XDC-60-2-3) ADVANCED CONFIGURATION STUDY, DESIGN. (General Electric Co., Cincinnati, Ohio (USA). Aircraft Nuclear Propulsion Dept.). 29 Feb 1960. Contract AT(11-1)-171. 251p. Dep. NTIS $14.75.

Declassified 20 Sep 1973.

A comparative evaluation of the three basic nuclear powered turbojet configurations and turbofan and turboprop variations is presented. Information is presented concerning power plant structure, the reactor, nuclear shielding, turbomachinery, control system, power plant cooling, remote handling, materials development, component development, and studies of alternate components and arrangements. (DCC)

28731 NAVAL NUCLEAR PROPULSION PROGRAM, 1972–73. Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Second Congress, Second Session, and Ninety-Third Congress, First Session. Testimony of Vice Admiral H. G. Rickover, February 9, 1972, Part I and March 28, 1973, Part II. Washington, DC; Joint Committee on Atomic Energy (1974). 283p. GPO $2.25.

Reactor Safety and Environmental Aspects

Refer also to abstracts 26857, 26860, 26867, 27264, 27424, 28627, 28636, 28682, 28683, and 28701.

28732 (CONF-740401-1) END TO HYPOTHETICAL SAFETY. Graham, J. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1973. Contract AT(45-1)-2171. 19p. Dep. NTIS $3.00.

From conference on fast reactor safety; Los Angeles, California, USA (2 Apr 1974).

It is shown that the design of safety features for hypothetical accidents in LMFBR's has in some cases detracted from the real functional safety of the plants. An alternative approach to the question of safety in LMFBR's is suggested. (JWR)

28733 (GA-A-12493) OXIDE-3: A COMPUTER CODE FOR ANALYSIS OF HTGR STEAM OR AIR INGRESS ACCIDENTS. Peroomian, M. B.; Barsell, A. W.; Saeger, J. C. (General Atomic Co., San Diego, Calif. (USA)). 15 Jan 1974. 126p. (GA-LTR-7).

OXIDE-3 is a third generation computer code developed for the purpose of analyzing the transient response following accidental inleakage of steam and/or air to the primary coolant system of a High-Temperature Gas-Cooled Reactor (HTGR). Based on defined (input) primary system transients and oxidant ingress rates, mass continuity and state equations are solved for all gaseous species assuming perfect mixing in core inlet and outlet plenums. The core is modeled by up to 3400 nodes for regional orificed coolant flow, heat generation and heat transport, in-pore diffusion and chemical reaction of oxidant gases (H_2O and O_2) and generated products (CO and H_2), and potential fission product release due to graphite oxidation and fuel hydrolysis. Plant protection system actions of moisture detection and reactor trip, steam generator isolation and dump, and safety valve pressure relief to the containment building can be simulated. (auth)

28734 (GA-A-12692) CONTEMPT-G COMPUTER PROGRAM AND ITS APPLICATION TO HTGR CONTAINMENTS. MacNab, D. I. (General Atomic Co., San Diego, Calif. (USA)). 1 Feb 1974. 107p.

The CONTEMPT-G computer program has been developed by General Atomic Company to simulate the temperature-pressure response of a containment atmosphere to postulated depressurization of High-Temperature Gas-Cooled Reactor (HTGR) primary or secondary coolant circuits. Part A of this report presents the mathematical models currently used in the code. Part B demonstrates the application of the code and offers examples of the atmospheric response of a representative containment to a variety of postulated HTGR accident conditions. In particular, maximum containment temperature and pressure, equilibrated long-term

prestressed concrete reactor vessel and containment pressures, and peak containment conditions following steam pipe ruptures are examined for a representative 770-MW(e) HTGR. (auth)

28735 (GEAP-13276-1) BWR BLOWDOWN HEAT TRANSFER PROGRAM. Task C4 Report: Preliminary System Design Description of Two-Loop Test Apparatus. Revision 1. Burnette, G. W.; Danielson, D. W.; Nilsson, K. A. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Nov 1973. Contract AT(04-3)-189. 142p. Dep. NTIS $5.45.

A two-loop test apparatus to be used in the BWR Blowdown Heat Transfer Program is described. The apparatus will be used for investigation of reactor blowdown heat transfer phenomena during representative loss-of-coolant accidents including the hypothetical recirculation line break (design basis accident). For physical scaling purposes, a typical boiling water reactor is modeled. Program background is outlined and program objectives are defined. Design basis is presented together with a detailed description of test apparatus operating performance. Measurement systems and data handling equipment are described in detail. Finally, performance predictions for the test apparatus are compared with boiling water reactor expected performance and with the design basis accident analysis performance. (auth)

28736 (IRS-W-8) FAILURE RATE COMPILATION. Balfanz, H.-P. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F.R. Germany)). Dec 1973. 95p. (In German). Dep. NTIS (U.S. Sales Only) $7.75.

The failure rates of mechanical and electrical components which are available from the IRS literature reserves are compiled. The compilation contains both numerical values and pertinent qualifying comments about the failure rates taken directly from the literature. Comments are given about the performance, the range of application of the components and/or the statistical data from which the failure rates have been estimated (i.e., number of observed components, the observation period and the number of failures). When possible, the failure rates of components were classified according to their range of performance or design characteristics. A differentiation of failure rates with failure modes, however, could only be made in a few circumstances. Because of the magnitude of data contained within the FARADA-Handbook (10), MIL-HDBK (15) and the VDEW-Statistic (18) the failure rates listed within these reports are summarized. A general averaging of all values, however, has not been considered to be suitable because failure rates should be chosen for specific conditions of component application. (auth)

28737 (NEDM-10735(Supp.6,7 and 8)) FUEL DENSIFICATION EFFECTS ON GENERAL ELECTRIC BOILING WATER REACTOR FUEL. (General Electric Co., San Jose, Calif. (USA). Atomic Power Equipment Dept.). Aug 1973. 260p.

The assumed effects of fuel densification considered are the potential for, (1) local power spikes resulting from axial fuel column gaps, (2) increased linear heat generation rate due to pellet axial shrinkage, (3) cladding collapse at the location of axial fuel column gaps, and (4) reduced pellet-clad thermal conductance due to increased pellet-to-clad gap as it may influence stored energy. The results of conservative analyses of local power spikes are presented. These analyses yielded the conclusion that there is >95% confidence that no more than one rod in any GE/BWR fuel type will have a power spike >5% in magnitude. This maximum spike magnitude will not occur at the limiting or highest power generation axial location in the rod. This analysis involves application of a maximum gap size which is larger than observed in BWR fuel. If the GE recommended maximum gap size were employed the resulting penalty is essentially zero. The results of the analysis of linear heat generation rate change due to densification show that the pellet axial shrinkage due to densification will be more than offset by the effects of axial thermal expansion. Thus no effect on LHGR is expected. The results of analyses of cladding creep collapse for existing BWR fuel types with more than one cycle of operation are also summarized. The results show that creep collapse will not occur. Evaluations were calculated for existing fuel operating through September of 1974. The gap conductances resulting from application of the AEC Staff model are presented for two alternative approaches to statistically treating the GE gap conductance data. These results are employed in the loss of coolant accident (LOCA) analyses for each fuel type. (auth)

28738 (NP-19962) NUCLEAR POWER PLANT SITING, 9–11 OCTOBER 1973, WASHINGTON, D. C. Warren, F. H. (Atomic Industrial Forum, Inc., New York (USA)). 1973. 42p.

A review of the proceedings of the Atomic Industrial Forum seminar on nuclear power plant siting is presented. The review is presented in four principal phases: (1) current methodologies in siting; (2) state power plant siting requirements; (3) federal legislation affecting siting; and (4) AEC regulations affecting siting. (JWR)

28739 (NP-19965) ENVIRONMENTAL, TECHNICAL, LEGAL, AND SAFETY ASPECTS RELATED TO FLOATING NUCLEAR POWER PLANTS OFF THE COAST OF CALIFORNIA. Okrent, D.; Catton, I.; Collison, T. D. (California Univ., Los Angeles (USA)). Apr 1973. 95p.

The California coast is bordered with a very narrow fringe of shelf, cut in several places with deeply plunging canyons and separated from the off-shore islands by deep basins. Thus, there are several types of off-shore sites for nuclear power plants, quite different in character from Gulf or Atlantic sites. In particular there are few sites in water shallow enough to allow a breakwater to be based on the bottom. The study of a new concept for off-shore plants is presented, substituting a free-floating ship-collision barrier for the breakwater—a concept potentially appropriate to most of the possible west coast sites. The chosen sites deliberately included a (1) sea mount, (2) a submarine canyon, and (3) the vicinity of a Channel Island, as well as a (4) flat bottom site, in order to encompass many of the typical problems which might arise. Distances from shore beyond the three-mile limit were also included to define their associated legal and technical problems. The scope of the study was intentionally broad, including conceptual platform design, radiological considerations, electrical power transmission, nuclear safety, and thermal discharges and biological effects. The depth of the study varied widely from topic to topic, ranging from little more than an identification of potential problems to an evaluation of current technology and some preliminary specification of preferred approaches. (auth)

28740 (NP-19965(App.)) APPENDICES TO ENVIRONMENTAL, TECHNICAL, LEGAL, AND SAFETY ASPECTS RELATED TO FLOATING NUCLEAR POWER PLANTS OFF THE COAST OF CALIFORNIA. Okrent, D.; Catton, I.; Collison, T. D. (California Univ., Los Angeles (USA)). Apr 1973. 368p.

Analyses are presented for various legal and technical aspects of floating nuclear power plants off the California coast. The appendices include: (1) AEC regulatory review; (2) site characteristics; (3) barge design, mooring, and collision protection; (4) power transmission; (5) waste heat dissipation; (6) thermal effects on marine biology; (7) radioactivity releases; and (8) legal and regulatory aspects. (HDR)

28741 (WASH-1110(2nd Ed.)) LMFBR: LIQUID METAL FAST BREEDER REACTOR PROGRAM PLAN. Element 10. Safety. (Argonne National Lab., Ill. (USA)). Dec 1972. 233p. Dep. NTIS $3.00.

The general objective of the LMFBR Safety program is to improve—through a research, development, and testing program—the technological base needed (1) to develop standards and codes for the safe design, siting, construction, and operation of both AEC test facilities and commercial LMFBRs; (2) to develop and evaluate safety systems; and (3) to provide realism and confidence in understanding and analyzing accident situations. The schedule for the ongoing improvement of the technological base considers both the near-term needs of the design and licensing sequences of FFTF and the demonstration plants and the long-term needs of large commercial LMFBR power stations (target plants). The Safety program takes into consideration the design, licensing, and operating experiences of the Enrico Fermi, EBR-II, and SEFOR reactors, of foreign FBRs, and of recent, large light-water reactors. Maximum advantage is taken of the experience gained in the safety program for water reactors. Safety program objectives include: (1) Sound basis for the development by industry and the AEC of safety criteria, codes, standards, regulations, and evaluation techniques; (2) Fully developed and tested core-protection and consequence-limiting safety systems; (3) Guidance for the Safety program from reviews of safety analysis reports and from LMFBR design studies; (4) Practical codes for analysis of accidents, including mathematical models and the experimental information and data to carry out safety evaluations and to assess safety margins; (5) The development of the facilities needed to carry out the Safety program and to provide firm demonstrations of the adequacy of accident-analysis capability, the performance of safety systems and instrumentation, and the establishment of safety margins. (auth)

28742 (Y-EC-267) COOLING REQUIREMENTS FOR THE NUCLEAR INDUSTRY. Shapiro, T. (Oak Ridge Y-12 Plant, Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 22p. (CONF-740107-1). Dep. NTIS $3.25.

From Cooling Tower Institute annual meeting; New Orleans, Louisiana, USA (28 Jan 1974).

Water requirements for existing and proposed nuclear power plants are discussed in terms of: cooling water requirements for

nuclear power plants; the discharge of thermal effluents from nuclear power plants to surface waters and to the atmosphere via cooling towers; and water requirements for nuclear power plant support activities such as uranium mining, ore processing, uranium hexafluoride production, uranium enrichment process cooling, fuel fabrication, and fuel reprocessing. It is concluded, on the basis of currently available limited data, that, although the use of water and the release of heat from nuclear power plants will affect the environment, detrimental environmental effects are not a necessary consequence of the expanding nuclear program. (LCL)

28743 FULL SCALE SAFETY EXPERIMENTS OF PRESSURE TUBE TYPE REACTOR. Heavy Water Moderated Boiling Light Water Cooled Reactor. Tokumitsu, M. Technical Meeting No. 4/11. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Results on the blowdown testing of the FUGEN heavy water moderated boiling light water cooled reactor carried out in the full scale safety experimental facility at PNC are presented. (auth)

28744 SEISMIC DESIGN SPECTRA FOR NUCLEAR POWER PLANTS. Newmark, N. M. (Consulting Engineering Services, Urbana, IL); Blume, J. A.; Kapur, K. K. J. Power Div., Amer. Soc. Civil Eng.; 99: No. PO2, 287-303(Nov 1973).

Statistical studies made recently, independently by the Blume and the Newmark organizations for the AEC, of a number of earthquakes are reported with a view toward developing recommendations for design response spectra to be used for nuclear power plant facilities. Recommended criteria and design spectra are reported that differ somewhat from previous recommendations but which are generally in accord with current practice. The new recommendations are more rational than previous ones in the sense that they are consistent with the results of a larger number of observations, and will generally tend to agree better with response spectrum calculations made for the same earthquake history with different levels of damping. Recommendations are also included regarding other seismic design criteria for nuclear power plants, including damping values and combination of response components. (auth)

28745 SYSTEMS ASPECTS OF SEISMIC DESIGN FOR NUCLEAR PLANTS. Sharpe, R. L. (John A. Blume and Associates, Engineers, San Francisco). J. Power Div., Amer. Soc. Civil Eng.; 99: No. PO1, 175-192(May 1973).

The response interactions between structural, mechanical, and electrical systems in a nuclear power plant subjected to earthquake motions are complex. Close communication and coordination between the design disciplines involved are essential during all phases of the feasibility-design-construct process to ensure that proper and timely consideration is given to seismic effects. Procedures for determining the interactive effects between structures and the systems and components supported thereon are reviewed. Design procedures to ensure timely interfacing of the design disciplines are recommended together with ground motion spectral shapes and suggested damping values. The need for overall system engineering coordination is reviewed together with recommendations for clear specifications and careful quality assurance throughout the design construction. (auth)

28746 ENGINEERING INNOVATIONS FOR DAVIS-BESSE CONTAINMENT. Wahl, H. W. (Bechtel Corp., San Francisco). J. Power Div., Amer. Soc. Civil Eng.; 99: No. PO1, 125-137 (May 1973).

Design and construction innovations relative to size, construction sequence, and testing are presented to show how they provided maximum schedule flexibility to permit the containment vessel and shield building to be built on schedule despite serious delays caused by AEC licensing hearings. These innovations consisted of: (1) Sufficient additional volume to preclude field stress relieving; (2) two-stage construction permitting simultaneous erection of the steel vessel and concrete of the vessel bottom head; (3) use of sufficient winter protection; and (4) elimination of the initial bare-vessel test with a single combined integrated leak rate test and structural integrity test conducted at the end of the overall plant construction. (auth)

28747 SEISMIC INSTRUMENTATION FOR NUCLEAR POWER PLANTS. Morcos, A. (Sargent and Lundy Engineers, Chicago); Chu, S. L. J. Power Div., Amer. Soc. Civil Eng.; 99: No. PO2, 281-285(Nov 1973).

Seismic instrumentation used to measure earthquake response in a nuclear power plant is considered. Recommendations concerning the instruments to be used and their locations in the plant are presented. It is suggested that a central recording unit be placed in the control area. This unit is connected to three triaxial accelerographs that measure acceleration time history at the basement of the reactor building, high in the reactor building, and at a location outside the plant. A number of peak accelerographs placed throughout the plant are also recommended. A plan of action to be followed by the plant operator and the plant owner in case of earthquake is presented. (auth)

28748 HUTCHINSON ISLAND NUCLEAR CONTAINMENT STRUCTURE. Moreland, R. G. (Ebasco Services Inc., New York); Bentley, R. L. J. Power Div., Amer. Soc. Civil Eng.; 99: No. PO1, 41-50(May 1973).

The nuclear steel containment vessel at the Florida Power & Light Company Plant was successfully post weld heat treated at the site. The entire heat treating operation was continuous for approximately 99 hr which includes holding time and controlled cool-down. The temperature reached was 1,150°F as required by the ASME Code. The vessel is in the form of a 140 ft diam cylinder, 127 ft long with a hemi-ellipsoidal bottom head and a hemispherical dome. The total weight is approximately 4,500 tons. To accommodate the expected growth of 14 in. in the diameter during heat treatment, the vessel was supported on a series of A frame columns which were hinged at the top and bottom. These temporary supports were adjusted for equal loading. The necessary adjustment was determined by taking strain measurements in each leg after a portion of the brssel had been erected. The vessel was heated by eight oil-fired burners, each rated at 30,000,000 Btu per hr, four located in the bottom head and four approximately halfway up the cylinder. (auth)

28749 SEQUOYAH ICE CONDENSER CONTAINMENT STRUCTURE. Allred, J. F.; Barnett, R. O.; Stidham, F. D. (Tennessee Valley Authority, Knoxville, TN). J. Power Div., Amer. Soc. Civil Eng.; 99: No. PO1, 19-40(May 1973).

The Sequoyah Nuclear Plant, (TVA) contains two Westinghouse Electric Corporation 1221-Mwe units with a pressurized water steam supply system and an ice condenser containment. This plant is designed to absorb the energy from accidental ruptures of the reactor coolant system by routing the flow of steam through 1,200 tons of ice. The routing of steam is accomplished by an internal reinforced concrete structure that houses the reactor and steam generator equipment. By using the ice to absorb the energy, the containment pressure is reduced and contained inside a freestanding steel vessel. The structural loadings, methods of analysis, allowable stresses, and controlling design conditions for the concrete shield building, structural steel freestanding containment vessel, and internal concrete structure are examined. (auth)

28750 BEAVER VALLEY CONTAINMENT STRUCTURE. Popper, S. H. (Stone and Webster Engineering Corp., Boston). J. Power Div., Amer. Soc. Civil Eng.; 99: No. PO1, 51-67(May 1973).

Unusual design concepts as well as more formalized approaches are required in the design of a containment structure. Governing loading conditions must be recognized and criteria established for delineating maximum loads. Design loads for both external loading and internal loading caused by seismic and pipe break conditions require careful analysis to provide maximum design criteria. The large forces existing in the mat shell and dome are investigated and solutions obtained that are both economical and practical. The liner and penetrations through the shell are analyzed to provide compatibility with the rest of the structure. Materials such as concrete and reinforcing steel must be carefully reviewed for maximum utilization and control. Construction freatures form an integral part in the development and design of the structure. A proof test is used to establish the structural integrity of the structure. (auth)

28751 OPTIMIZATION OF CIRCULATING WATER SYSTEM. Gupta, R. S. (Worcester Polytechnic Inst., MA); Webber, B. R. J. Power Div., Amer. Soc. Civil Eng.; 99: No. PO1, 235-247(May 1973).

Due to strict thermal standards, utilities are forced to look for efficient and economic methods of removing waste heat from steam electric generating plants. This paper presents a code for optimizing the circulating water system such that requirements imposed by state and Federal Authorities are not violated. Two large cooling towers, a 135-acre cooling pond and the circulating water system are coupled together. The major savings realized as a result of this code are: (1) a minimization of the number of operating circulating water pumps, circulating water booster pumps, and cooling water fans; (2) a maximization of (within limitations) the amount of heat rejected to the river; and (3) a minimization of unit heat rate consistent with existing conditions and limitations. (auth)

Reactor Theory and Calculation

Refer also to abstracts 28281 and 28676.

28752 (AAEC/E-296) COMPARISON BETWEEN EXPERIMENTALLY DETERMINED FLOW INSTABILITY THRESHOLDS AND CALCULATIONS USING THE COMPUTER CODE TOSCLE. Wilson, D. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec 1973. 25p. Dep. NTIS (U. S. Sales Only) $3.25.

Experimental results from the Canadian forced convection loop FLARE (D'Arcy 1968) have been used to assess the value of the TOSCLE computer code (Spinks 1971) for calculating flow stability characteristics of pressure tube reactor systems. Good agreement has been found between TOSCLE calculations and the FLARE results for high values of subcooling. TOSCLE indicated a crucial boiling length as supposed by Shotkin (1967). However, this does not appear to be consistent with the FLARE experimental data and large discrepancies occur at low subcoolings. The experimental results showed an increased scatter in the low subcooling region. A possible cause for this and for the discrepancy with calculated results at low subcooling are suggested. The sensitivity of TOSCLE results to various input parameters was examined. Most parameter variations were found to have only a minor effect on the results. Further experimental work in conjunction with detailed theoretical analysis is essential, particularly in the area of low subcooling which is of great importance in power reactor design. (auth)

28753 (AEEW-M-1242) ONE GROUP FISSION PRODUCT CAPTURE CROSS-SECTIONS AS USED IN FAST REACTOR CALCULATIONS. Dean, C. J. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Jan 1974. 8p. Dep. NTIS (U.S. Sales Only) $3.00.

In order to give a broad comparison of the various cross-section evaluations available for use in fast reactor calculations a typical fast reactor spectrum has been used to form 1-group cross-sections. This spectrum averaged over the 37 energy groups of the FD5 set is given. One-group capture cross-sections for fission products condensed from the 1971 Lucas Heights data, and the Australian and Italian combined evaluation of 1967 over the energy range 10 MeV to 0.0001 eV using this standard fast reactor spectrum are presented. (auth)

28754 (EURFNR-1150) KAPER: LATTICE PROGRAM FOR HETEROGENEOUS CRITICAL FACILITIES (USER'S GUIDE). McGrath, P. E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Dec 1973. 73p. (KFK-1893). Dep. NTIS (U. S. Sales Only) $5.75.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Documentation is presented on the KAPER program, which is a multigroup lattice code developed to analyze experiments performed in plate-type heterogeneous critical facilities. Included is a detailed description of the input data required for the program, the structure of the program, and an outline of the theoretical methods utilized in the program. (auth)

28755 (ICP-1040) FISSION PRODUCT NUCLEAR DATA REQUIREMENTS FOR THE DETERMINATION OF NUCLEAR FUEL BURNUP: A REVIEW. Maeck, W. J. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs – Operations Office). Jan 1974. Contract AT(10-1)-1375. 36p. (CONF-731133-1). Dep. NTIS $4.00.

Specific needs for improved fission product nuclear data for the determination of nuclear fuel burnup are reviewed. The various techniques for measuring burnup, both destructive and non-destructive, are discussed with regard to applicability and to fission product nuclear data requirements. The highest priority fission product nuclear data requirements are for fast reactor fission yields as a function of neutron energy and for decay scheme data for radionuclides used as burnup monitors. New data showing the variation of fission yields with neutron energy and the need to associate all fast fission yields with a well defined spectral index are given. (auth)

28756 (INIS-mf-1026, pp 41-48, Sect. 4.2) EXPERIMENTAL INVESTIGATION OF THE TURBULENT EXCHANGE OF MASS BETWEEN ROD SUBCHANNELS. Green, W. J.; Hooper, J. D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1973.

The analysis of the thermal performance of fuel assemblies in nuclear power reactor cores is discussed. An experimental approach to the determination of turbulent mass exchange between fuel rod subchannels is outlined. In a reactor fuel assembly a subchannel can be defined by the flow area contained within straight lines joining the centers of rod fuel elements in square or triangular lattice array. Within such an arrangement for turbulent flow conditions there are basically two methods of exchange between the flow subchannels. One mechanism is caused by the pressure gradients existing between subchannels, and the other by the turbulent diffusion of mass and heat. The effects of geometrical configuration on the turbulent mass exchange process both within a subchannel and between subchannels were examined using a sixteen rod square pitch lattice as the rod array. The ratio of rod gap to rod diameter was varied between 0.07 and 1.2, at a Reynolds number of approximately 5×10^4. Air was used as the working fluid, the isokinetically injected nitrous oxide tracer gas was employed to determine concentration profiles within the central test subchannel. The radial diffusivity of mass within a subchannel and the transport of mass between subchannels were investigated. (INIS)

Reactor Components and Accessories

Refer also to abstracts 26801 and 27253.

Reactor Fuels

Refer also to abstracts 27195, 27196, 27199, 27203, 27207, 27257, 27275, and 27308.

Reactor Control Systems

Refer also to abstract 28637.

28757 (CEA-CONF-2493) CONTROL OF NUCLEAR REACTOR BY MINI-COMPUTER. Kaiser, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France)). 12 Nov 1973. 11p. (In French). (CONF-731213-2). Dep. NTIS (U.S. Sales Only) $3.00.

From 1st international symposium on GAMAC and on-line computers; Luxembourg (4 Dec 1973).

The use of small computers in process control allows decentralization of the control loop. This is possible with terminals connected eventually to a central computer. In reactor control, such a terminal may assure a measure function as well as a control function. (auth)

28758 (PWAC-497) SNAP-50 POWERPLANT SYSTEM CONTROL ANALYSIS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). Sep 1965. Contract AT(30-1)-2789. 105p. Dep. NTIS $8.25.

Declassified 12 Sep 1973.

The overall control concept of the SNAP-50 powerplant consists of open loop control. The reactor and the power conversion system are separately controlled to predetermined schedules. Attempts to slave the reactor to generator load proved unsatisfactory. The operating characteristics of the potassium boiler proved to be the key factor in the choice of control concept. To insure stable operation of the power conversion system, the boiler must deliver superheated vapor to the turbine. As the heat transfer coefficient for the vapor is small, the temperature of the lithium must be increased several degrees to obtain a small increase in superheat of the potassium. This results in a very weak coupling between the reactor and the power conversion system. The operational requirements of the boiler influence reactor inherent stability and control. In general, the margin of stability is reduced as superheat is increased. The basic control system of the SNAP-50 powerplant consists of: (1) Control of core exit lithium temperature to a scheduled value. The scheduled temperature is a function of scheduled load; (2) The control of turbine speed by means of a parasitic load. A potassium flow control valve is used to automatically recenter the parasitic load to a scheduled value; and (3) The control of generated voltage by means of a voltage regulator acting on field current. The controls and their effect upon the powerplant were studied for stability and performance. (auth)

28759 (WASH-1104(2nd Ed.)). LMFBR: LIQUID METAL FAST BREEDER REACTOR PROGRAM PLAN. Element 4. Instrumentation and Control. (Argonne National Lab., Ill. (USA)). Dec 1972. 237p. Dep. NTIS $3.00.

The Instrumentation and Control (I&C) Plan is designed to meet the need for reliable, commercially available instrumentation

that will provide reliable and accurate information from an LMFBR plant and adequately and safely control it. Instrumentation and control is also required for test facilities, highly-specialized tests and laboratory experiments that will provide: information for analysis and evaluation of components, equipment, and plant performance; confirmation of design prediction; and analysis of equipment malfunctions. Many of the instrumentation sensors associated with a reactor and its primary coolant system will be required to perform in the special LMFBR environment of high fast-neutron flux, intense gamma, and high liquid metal temperature. (auth)

28760 FLUID ACTUATORS FOR CONTROL AND SAFETY IN PRESSURE TUBE REACTORS. Broggi, A.; Peterlongo, G.; Tocconi, F. A. Technical Meeting No. 4/10. Basel; Nuclex (1972). 14p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Two systems, one for fine control and the other for fast shutdown, developed and tested for the CIRENE nuclear reactor prototype are described. These systems can be used without major modifications in any similar pressure tube reactor. (auth)

28761 EFFECT OF AUTOMATIC CONTROL SYSTEM ON POWER SPECTRAL DENSITY OF NEUTRON FLUCTUATIONS. Shimegi, N. (Hitachi Ltd., Kanagawa, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 10, 643-647 (Oct 1973).

Nuclear Power Plant Economics

Refer also to abstracts 28765 and 28794.

28762 DISTRICT HEATING CAN CUT WASTAGE FROM NUCLEAR PLANTS. Jenkins, N. Energy Int.; 11: No. 3, 25-26 (Mar 1974).

A review is given of progress made in several countries on the performances of nuclear power plants for combined production of electricity and hot water for district heating. Fear still exists about the safety of atomic power, and power plants will continue to reject twice as much heat energy as they use to generate electricity. The public must be persuaded that there is little risk and that precautions are taken to prevent disaster. (MCW)

28763 PUBLIC POLICY TOWARD ENVIRONMENT 1973: A REVIEW AND APPRAISAL. Nuclear and Other Energy. Seaborg, G. T. (Univ. of California, Berkeley); Bloom, J. L.; Nelson, E. L. Ann. N. Y. Acad. Sci.; 216: 79-88 (18 May 1973).

The applications of nuclear and other non-conventional sources of energy would lessen the dependence on imported fuels, conserve depletable oil and gas reserves; and ease adverse environmental impacts, especially in air pollution. The alternatives will have to prove a significant capacity over a long period to justify expenditures for R&D and other costs of the new technology. Environmental impacts must be reasonable. Geothermal, solar, wind, and tidal power are alternatives, but when the safety and environmental issues are satisfactorily resolved, nuclear power has the best prospect of meeting all these performance criteria. It is the only source capable of making a significant contribution in the near term. (MCW)

28764 REACTOR AS A SOURCE OF INDUSTRIAL ENERGY. Anderson, T. D.; Michel, J. W. Oak Ridge Nat. Lab. Rev.; 6: No. 3, 19-23 (Fal 1973).

The ideal requirement for nuclear power plants to have a role in the future supply of industrial energy will be one large industrial consumer with accompanying small industrial energy users. Nuclear power plants would be operated as dual-purpose plants supplying electricity to a power grid and process energy for local use. The plant could offer overall savings and relieve the demand for fossil fuels and the environmental problems associated with them. Obstacles to industrial nuclear energy are: (1) the time required to construct a nuclear plant is at present four to seven years longer than the time required to build most industrial plants; (2) the planning of nuclear plants for industry will in most cases involve a utility and one or more private companies that presents organizational problems; and (3) the siting, safety, and environmental considerations for nuclear plants and some industrial plants may be conflicting. (MCW)

Reactor Fuel Cycle Economics

Refer also to abstract 28674.

28765 (CONF-730986-) NUCLEAR POWER FINANCIAL CONSIDERATIONS, 18-21 September 1973, Monterey, California. (Atomic Industrial Forum, Inc., New York (USA)). 1973. 60p. Atomic Industrial Forum, $20.00.

Information is presented concerning nuclear power plant costs, fuel costs, fuel financing, and insurance requirements. (DCC)

28766 WORLD NUCLEAR FUEL MARKET INAUGURATED: WILL HEADQUARTER IN ATLANTA. Elec. Light Power, E/G Ed.; 52: No. 5, 1; 4 (Mar 1974).

Approximately 145 companies have joined or announced serious intentions of joining a World Nuclear Fuel Market that intends to become a non-government forum for activities in the movement, trade, and barter of nuclear fuels. The market will handle yellowcake, U-235, enriched uranium, plutonium as a nuclear fuel, and finished fuel assemblies. Services offered include conversion of yellowcake to UF_6; separative work for enrichment of UF_6 with the isotope U-235; and spent fuel reprocessing. The major objective of the market in Atlanta will be to keep close track of world-wide enrichment capacity. (MCW)

Reactor Licensing and Regulation

Refer also to abstracts 28738 and 28872.

28767 (DOCKET-50133-153) HUMBOLDT BAY POWER PLANT, UNIT 3. Semiannual Report on Operation, July 1, 1973-December 31, 1973. (Pacific Gas and Electric Co., San Francisco, Calif. (USA)). 1 Mar 1974. 81p. Dep. NTIS $6.25.

A summary of operations during the period includes data on facility design changes, power operation and performance characteristics, staff changes, maintenance, test activities, radioactive effluent releases, solid wastes, environmental radiation monitoring, and occupational personnel radiation exposure. (JWR)

28768 (DOCKET-50171-148) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Semiannual Operations Report, July 1, 1973-December 31, 1973. (Philadelphia Electric Co., Pa. (USA)). 28 Feb 1974. 34p. Dep. NTIS $3.75.

The operations summary for the period includes data on power and performance characteristics, safety system actions, radioactive effluents, area radiation surveys, personnel exposures, primary and secondary coolant chemistry, reactor maintenance, facility changes, test results, administration, and spent fuel pool maintenance. (JWR)

28769 (DOCKET-50213-280) HADDAM NECK PLANT. Semiannual Report on Radiological Environmental Monitoring Program, July 1, 1973-December 31, 1973. (Connecticut Yankee Atomic Power Co., Hartford (USA)). 26 Feb 1974. 31p. Dep. NTIS $3.75.

Sampling and analyses were performed on air particulates, gamma dose rate, river water, well water, soil, vegetation, bottom sediment, milk, clams, and fish. Based on data obtained, there is no significant radioactivity in the environment that can be attributed to plant operation. No significant differences in activity levels were noted between the inner and outer land monitoring stations. (auth)

28770 (DOCKET-50244-247) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Eighth Semiannual Report, July 1, 1973-December 31, 1973. (Rochester Gas and Electric Corp., N.Y. (USA)). 28 Feb 1974. 37p. Dep. NTIS $4.00.

Reactor operations and associated activities during the period July 1 through December 31, 1973 are reported. Data are included on power generation, shutdowns, maintenance, tests and experiments, radioactive effluent releases, solid waste, environmental monitoring, and occupational personnel radiation exposure. (JWR)

28771 (DOCKET-50245-339) MILLSTONE NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Semiannual Report on Radiological Environmental Monitoring Program, July 1, 1973-December 31, 1973. (Millstone Point Co., Hartford, Conn. (USA)). 26 Feb 1974. 48p. (DOCKET-50336-117; DOCKET-50423-64). Dep. NTIS $4.50.

The environmental radioactivity monitoring program continued in an expanded form for the period July through December 1973. Sampling and analyses were performed on gamma dose rate, air particulates, precipitation, soil, vegetation, milk, well water, aquatic flora, bottom sediment, shellfish, fish and sea water. The scope of the program was expanded to include additional sample locations and analysis for specific nuclides in a variety of sample media. Based on the data obtained, the only detectable radioactivity in the environment that can be attributed to the operation of Millstone Point Unit 1 was found in some marine samples

Certain isotopes, i.e., ^{58}Co, ^{60}Co, and ^{65}Zn were found in varying degrees in some oyster, mussel and rockweed samples and in the bottom sediment at Bay Point Beach. These nuclides were seen during previous report periods and are probably the result of plant operation in the fall of 1972. Differences in activity levels between the inner and outer land monitoring stations and the presence of radioactive isotopes in other samples are attributed to local soil conditions (e.g., high radioactivity content of granite), construction activity at the site and differences in precipitation rates of radionuclides from nuclear tests. The consistently higher gamma dose rates at the on-site locations were still seen during periods of plant shutdown. (auth)

28772 (DOCKET-50245-345) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Semiannual Operating Report, July 1, 1973–December 31, 1973. (Millstone Point Co., Hartford, Conn. (USA)). 1 Mar 1974. 64p. Dep. NTIS $6.25.

The feedwater sparger replacement was completed on July 3rd. Closing of the vessel and testing delayed start-up until July 13th. Several leaks delayed start-up to the 16th when notification of possible manufacturing defect in control rods delayed start-up until July 28th. The generator went on line on the 29th. A defective instrument caused a scram on the 30th. The generator returned to the line the same day and achieving a power of 70% by the end of the month. Power was increased to 100% on August 5th. Indication of feedwater sparger vibration forced power reduction to 80% on the 6th. A scram on the 10th attributed to instrument defect caused fourteen hours lost time. A second scram on the same day attributed to operator error cost four hours off line time. Power restored to 80% limit on the 11th continued to shut down on the 13th to correct a difference in reactor water level indications. Power was restored to the 80% limit on the 15th and remained there until September until the planned shutdown on the 14th to inspect hydraulic shock absorbers and conduct shutdown margin tests relative to the possible defects in control rod assemblies. Startup began on the 18th but was stopped by an instrument tap leak. A second start-up on the 19th was stopped by a leaking reactor automatic pressure relief valve. A reactor recirculation pump motor tripped. A third start-up on the 21st resulted in placing the generator on line for an hour when an EPR/MPR failure resulted in a scram. A fourth start-up on the 22nd brought the generator on line to 50% power which was then reduced to 40% for about 36 hours due to bearing problems with the condensate booster pumps. A series of reactor recirculation pump motor trips caused oscillation of power level between 67 and 80% for the remainder of the month. Failure of the reactor recirculation pump motor limited power to 68% for the remainder of the year. Three shutdowns totaling 77 hours were scheduled for tests and inspections related to the pump motor. Hydraulic snubber inspection commitments were met during these outages. Power was still limited to 68% due to recirculation pump motor failure. One shut down lasting 25 hours was scheduled to inspect and repair hydraulic shock absorbers. Power continued to be limited to 68%. In December, a scram causing five hours down time was attributed to a painter striking an instrument rack. An AEC test was conducted on the 21st which collected data on operation with reactor recirculation loop cross-tie valves open and one recirculation pump in operation. The plant was shut down for ten days on the 21st to replace the motor stator of the reactor recirculation pump. The retrofit program for hydraulic shock absorber "O" rings was completed at this time which increased the inspection interval required to 120 days. The final set of reactor shutdown margin tests was completed relative to the possible control rod problem. Recirculation motor replacement was completed on the 27th with testing and bearing replacement completed on the 29th. Initial start up on the 30th was stopped by an isolation condenser leak. Successful start-up on the 31st brought the generator on line achieving 62% power at end of month with a new upper limit of 80%. Summaries are presented on shutdowns, maintenance, changes in design and specifications, operating personnel radiation exposures, and radioactive effluent releases. (FS)

28773 (DOCKET-50255-225) PALISADES NUCLEAR PLANT. Semiannual Report of Operations, July 1–December 31, 1973. (Consumers Power Co., Jackson, Mich. (USA)). 27 Feb 1974. 422p. Dep. NTIS $23.25.

The plant was on line for 969 hours and generated a total of 642,620 MW(e) gross (616,873 MW(e) net) for the period. From July 1, 1973 until August 11, the plant operating level was essentially 100% (2,200 MW(t)) of full power. On August 11, the plant was shut down for steam generator tube repairs. Concurrently with these repairs, modifications were made to the reactor internals. The first year turbine generator inspection was in progress. In addition, the closed cycle condenser cooling system, which was constructed pursuant to the Intervenor Agreement, was cut in. The plant has remained shut down since August 11, 1973. Information is also presented concerning operating procedure changes, power generation, shutdowns, maintenance, in-service surveillance, facility changes, radioactive effluent releases, environmental radiological and nonradiological monitoring, biological conditions in Lake Michigan and psammolittoral data of Lake Michigan. (FS)

28774 (DOCKET-50277-190) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Semiannual Operations Report No. 1, July 1, 1973–December 31, 1973. (Philadelphia Electric Co., Pa. (USA)). 27 Feb 1974. 43p. Dep. NTIS $4.25.

Activities during the period July 1 through December 31, 1973 are reported. Chapters are included on operations, equipment, maintenance, radioactive waste, personnel exposure, and administration. (JWR)

28775 (DOCKET-50282-214) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Semiannual Environmental Studies Report No. 1, August 9, 1973–December 31, 1973. (Northern States Power Co., Minneapolis, Minn. (USA)). 28 Feb 1974. 12p. Dep. NTIS $3.00.

Environmental studies performed at or in the vicinity of the Praire Island-1 Reactor during the period August 9 through December 31, 1973 are reported. Data are presented on discharge temperatures, chlorine injections, corrosion inhibitors, hydrogen ion concentration, chemical additives, aquatic and terrestial studies, and fish impingements. (JWR)

28776 (DOCKET-50285-178) FORT CALHOUN STATION, UNIT 1. Operational Report on Environmental Radioactivity Surveillance Program, Third Quarter 1973. (Omaha Public Power District, Nebr. (USA)). 1973. 15p. Dep. NTIS $4.00.

Data for the third quarter of 1973 indicated an average background radiation dose rate of 1.7 mrem/week. Beta radioactivity in air particulate samples remained at very low concentrations for the period, ranging from less than 0.01 to 0.23 pCi/m^3. The only gamma emitter present in measurable amounts in monthly composite samples was Be-7 with concentrations ranging from .03 to .11 pCi/m^3. Beta radioactivity in surface water ranged from less than 2 to 35 pCi/l. The highest concentrations were observed in samples that contained large amounts of suspended silt which contains K-40, Ra-226 and other naturally occurring radionuclides. Tritium concentrations ranged from less than 0.2 to 0.8 pCi/ml. Beta radioactivity in well water sampled was below 10 pCi/l. The only gamma emitters detected in silt samples were naturally occurring K-40 and decay products of uranium and thorium. Sr-90 was measured by radiochemistry at a concentration of approximately 0.4 pCi/g (dry). Soil samples contained the usual naturally occurring gamma emitters as well as small amounts of Sr-90 and Cs-137. Almost all of the beta radioactivity in fish, other aquatic biota, food crops and milk is due to natural K-40. One rhubarb sample collected 10 October 1973, had a Sr-90 content of 0.53 ± .06 pCi/gm dry weight. This value is somewhat higher than usual for most types of vegetation. The wet to dry weight ratio of this sample was 15.5 and the "as received" Sr-90 concentration was, therefore, 0.034 ± .004 pCi/gm. This level is not considered to be significant in a single sample. Sr-90 in preserved milk samples was detected at levels below 10 pCi/l. Cs-137 concentrations were below 10 pCi/l in milk and less than 1 pCi/gm in foodstuffs. Milk samples collected throughout July and most of August contained amounts of I-131 clearly measurable by high-sensitivity analytical methods. No environmental samples collected and analyzed in this program during this period displayed any radioactivity which could be attributed to the operation of the Ft. Calhoun Nuclear Power Station. (auth)

28777 (DOCKET-50295-247) ZION NUCLEAR PLANT, UNITS 1 AND 2. Semiannual Report on Radioactive Waste and Environmental Monitoring, July–December 1973. (Commonwealth Edison Co., Chicago, Ill. (USA)). 25 Feb 1974. 60p. (DOCKET-50304-177). Dep. NTIS $5.00.

During the last six months of 1973, less than two curies of gaseous activity was released from Zion Station. This value is a small fraction of the limits in the Technical Specifications. No particulate releases in the gaseous effluents were detected. There was no radioactivity released in the liquid effluents during the reporting period. The radiological and meteorological data for the reporting period indicate that environmental levels of radionuclides attributable to the operation of the plant are such that the resultant dose to the public is unlikely to exceed 1% of the dose that would result from continuous exposure to the concentration values listed in Appendix B, Table II of 10CFR20. (auth)

28778 (DOCKET-50409-105) LACROSSE BOILING WATER REACTOR. Monthly Operating Report for December 1973. (Dairyland Power Cooperative, La Crosse, Wis. (USA)). 1973. 43p. (LAC-TR-6). Dep. NTIS $4.25.

Refueling and semi-annual maintenance period was completed

December 21, 1973. Thirty-two zirconium shroud cans were removed from the core and replaced with stainless steel cans previously used in the initial core. Twenty-five fresh Type II elements were loaded into the core. Plant startup commenced December 21, 1973, with a maximum power of 65% achieved this reporting period. The reactor was critical 224.4 hours with the turbine generator connected to the DPC grid for 117 hours. Seven reactor criticals were conducted for operator training. The major problems encountered on plant startup were malfunctions of the reactor feed pump controllers and leakage from control rod drive No. 2 upper mechanism mechanical seal. Data are presented for in-plant and environmental monitoring, waste disposal, and recirculating system leak monitoring. Electrical and mechanical maintenance are discussed. Technical specification changes, operating procedures and memoranda, health and safety memoranda, and facility changes are summarized. (FS)

28779 (RAI-74-2) REGULATORY ADJUDICATION ISSUANCES AND ISSUANCES OF THE BOARD OF CONTRACT APPEALS, FEBRUARY 1974. (USAEC Technical Information Center, Oak Ridge, Tenn.). Mar 1974. 50p. TIC $2.80.

Issuances received during February 1974 from the Commission (CLI), the Atomic Safety and Licensing and Appeals Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), and the Board of Contract Appeals (BCA) are presented. (auth)

28780 CURRENT APPROACH TO LICENSING NUCLEAR POWER PLANTS. Price, H. L. At. Energy Law J.; 15: No. 4, 227-237(Win 1974).

Steps in the system of licensing nuclear power plants where delays can occur are listed. It is pointed out that there is potential in the operating permit stage for further delays, and it is felt that all the important nuclear safety and environmental questions should be resolved at the construction permit stage. Comments are offered on rule-making procedures; it is hoped that rule-making hearings can be conducted in legislative style rather than trial style. The fate of the safety research program under the proposed split of AEC is considered, and it is proposed that the program be put into the regulatory agency (NEC). (DLC)

28781 MEETING THE CHALLENGE TO NUCLEAR ENERGY HEAD-ON. Doub, W. O. (Atomic Energy Commission, Washington, DC). At. Energy Law J.; 15: No. 4, 238-264(Win 1974).

The problem of what can be done to streamline the process to license and build commercial reactors is addressed. Of the 36 nuclear plants scheduled for completion before Jan 1976, 21 have been identified by FPC as high-priority projects, but their construction cannot be accelerated any further to a significant degree. Causes of schedule delays in 28 plants scheduled for 1973 operation are discussed. Actions to minimize racheting (changes in licensing requirements) are described briefly. Time savings possible from standardized plants and designated sites are considered; use of preconstruction permit exemptions is also discussed. Steps have been taken to increase availability of regulatory information to the public and thus improve the public debate over nuclear power. (DLC)

GENERAL

Energy Utilization and Economics

Refer also to abstracts 26545 and 28870.

28782 (AD-766329-7) RESEARCH ON ELECTROCHEMICAL ENERGY CONVERSION SYSTEMS. Interim Technical Report No. 3, October 1972–April 1973. Adams, A. A.; Foley, R. T.; Goodman, R. M. (American Univ., Washington, D. C.). Jun 1973. Contract DAAK02-72-C-0084. 58p. NTIS $3.50.

The research on electrochemical energy conversion systems has involved work on two tasks: a search for electrolytes alternative to phosphoric acid for direct and indirect hydrocarbon-air fuel cells, and a study of the corrosion characteristics of electrolytes for intermediate-temperature hydrocarbon-air fuel cells. The work during this reporting period was concentrated on the first task. Two alternative electrolytes, trifluoromethanesulfonic acid monohydrate and dichloroacetic acid, representative of two classes of compounds, were studied in some depth. The first compound shows definite promise as an alternative electrolyte. It is physically and electrochemically stable up to 135C for periods of time up to six weeks. The limiting current density for the oxidation of propane at 135C is approximately 15 times that observed in H_3PO_4 at the same temperature. Certain problems associated with the use of dichloroacetic acid were encountered. These were interpreted in terms of the state of the "unbound" water in the electrolyte. (GRA)

28783 (AD-766855-1) DEVELOPMENT OF GEOTHERMAL RESERVOIRS FROM OVERPRESSURED AREAS BENEATH THE GULF COASTAL PLAIN OF TEXAS. A Feasibility Study of Power Production From Overpressured Reservoirs. Final Report. Herrin, E. (Southern Methodist Univ., Dallas, Tex. (USA)). Mar 1973. 148p. (AFOSR-TR-73-1344). NTIS $9.50.

It is the purpose of the present study to determine the feasibility of locating a pilot project in the Texas Gulf Coast area for the purpose of tapping the overpressured aquifers and transforming the thermal and mechanical energy into electrical power. Three areas in south Texas chosen were the Sebastian area in northwest Cameron County, the Port Mansfield area in eastern Willacy County, and the Corpus Christi area. (GRA)

28784 (AD-768232-1-GA) CONSEQUENCES OF THE PRESENT POLICY OF DEMAND ACCOMMODATION. Doctor, R. D. (Rand Corp., Santa Monica, Calif. (USA)). Apr 1973. 20p. (P-5016). NTIS $3.00.

Potential technological solutions to the problems caused by continuing rapid growth of electricity demand are examined. It finds these technological solutions by themselves are inadequate. It concludes that there is a clear need to consider and evaluate policies that attack the root of the problem—the rapidly growing demand for electricity. Combined with other policies to stretch the fuel resource base, a policy of slowing the growth of California's electricity consumption could provide us with sufficient time for the resolution of current controversies and the development of new environmentally compatible supply technologies. (GRA)

28785 (AD-768292-5-GA) EARTH HEAT SINKS FOR UNDERGROUND POWER SOURCES. Garg, S. C. (Naval Civil Engineering Lab., Port Hueneme, Calif. (USA)). Aug 1973. 83p. (NCEL-TN-1306). NTIS $3.75.

The cost effectiveness of Earth heat sinks for underground power plants operating in a closed cycle over limited durations in time was determined through a transient heat conduction analysis. A comparison of heat absorption capacity of Earth heat sinks per cubic foot volume with the capacities of stored water and stored ice heat sinks was carried out for a specific set of operating conditions. The comparison has shown that the cost of an Earth heat sink using select backfill is approximately 6 and 14% of the cost of a stored ice heat sink, and approximately 10 and 23% of the cost of a stored water heat sink at sites with full and zero water tables, respectively. The overall volume of the Earth heat sink was estimated to be 0.8 and 1.5 times the volumes of stored water and stored ice heat sinks, respectively. It is recommended that Earth should be considered as an alternative waste heat sink for limited duration, closed cycle underground power systems because of its simplicity and lower cost. (GRA)

28786 (BNL-18719) APPLICATION OF METAL HYDRIDES TO GROUND TRANSPORT. Waide, C. H.; Reilly, J. J.; Wiswall, R. H. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 11p. (CONF-740306-10). Dep. NTIS $4.00.

From hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

Hydrogen, an alternative to gasoline fuel in vehicle applications, can be stored as a metal hydride and released for use by the application of waste heat from the engine. Present investigations include a review of known and possible hydrides with a potential for automotive use. Hydride bed types and their application to vehicles are discussed. $FeTiH_2$ and MgH_2 are considered. Their merits and potential for use in meeting various transportation needs are discussed. Implementation through fleet vehicle systems is proposed as a means of gaining practical experience with reasonable control during the introduction of the advanced technology. (auth)

28787 (BNL-18720) MODELING STUDIES OF FIXED-BED METAL-HYDRIDE STORAGE SYSTEMS. Yu, W. S.; Sauberg, E.; Waide, C. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 14p. (CONF-740306-11). Dep. NTIS $4.00.

From hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

Modelling studies are of a practical importance in understanding and characterizing the behavior of hydride beds now being developed for storing and supplying hydrogen fuel in power plant and automotive applications. A convection bed model, in which heat is transferred to or from the bed by a flowing stream of hydrogen in direct contact with the particles, and a conduction model in which heat is transferred through a containment wall, were developed. $FeTiH_2$ and catalyzed MgH_2 were evaluated using the model. (auth)

28788 (BNL-18721) ROLE OF HYDROGEN IN ELECTRIC ENERGY STORAGE. Salzano, F. J.; Cherniavsky, E. A.; Isler, R. J.; Hoffman, K. C. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 16p. (CONF-740306-9). Dep. NTIS $4.00.

From hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

Electricity must be provided by the utilities on demand that varies daily, weekly, and in a seasonal cycle. This results in the under-utilization of high capital cost generating facilities and the reliance on peaking devices such as gas turbines and pumped storage. Gas turbine generators, though presently economical, are highly inefficient and use high grade liquid or gaseous fossil fuels which may eventually be in short supply. The role of electric storage in utility systems is discussed. The technology of hydrogen production, storage, and reconversion to electricity as a technique for electric energy storage is discussed and shown by means of an optimization model to fit well into the United States energy system. (auth)

28789 (COM-73-50799-8-GA) SEVEN WAYS TO REDUCE FUEL CONSUMPTION IN HOUSEHOLD HEATING THROUGH ENERGY CONSERVATION. Knauer, V.; Kushner, L. M. (National Bureau of Standards, Washington, D. C. (USA)). Dec 1972. 12p. GPO $0.35.

Increasing demand for natural gas, No. 2 heating oil, low-sulfur residual fuel oil, low sulfur bituminous coal, and electricity in the United States is imposing great pressures on available supplies. Conservation in the use of fuel and energy can reduce these pressures on demand, and at the same time provide the additional benefit of a reduction in environmental pollution. Practical ways by which one can conserve are: reset thermostat to lowest acceptable setting, such as two or three degrees below usual setting; service oil burners regularly (including replacement of filters) and turn off heat supply in unused rooms; keep draperies, shades and shutters closed except when needed for light; reduce the consumption of electricity during late afternoon and early evening periods; and improve insulation in attics and around doors and windows. (GRA)

28790 (CONF-740214-2) ENERGY DEMAND ANALYSIS AND FORECASTING. Kaplan, S. I. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 10p. Dep. NTIS $3.00.

From conference on energy conservation research; Warrenton, Virginia, USA (18 Feb 1974).

Energy demand by 12 major industries of the economy is studied. The companies used nearly two-thirds of the energy consumed in all manufacturing processes in 1971. The consumption pattern for electricity and the various sources of thermal energy over the past decade for each industry are recorded. Changes in manufacturing processes that resulted in the energy use pattern are noted. An evaluation was made of the most promising alternative strategies open to industry management as it struggles with rising costs of energy and raw materials. These take the form of internal conservation of energy usage by eliminating

energy leaks and making more efficient use of the energy content of waste streams. Energy consumption for 1971 was calculated for industrial chemicals; blast furnace and basic steel products; petroleum refining; paper mills; paperboard mills; hydraulic cement; plastic materials and synthetics; primary nonferrous metals; glass or glassware; flat glass; concrete, gypsum, and plaster; and motor vehicles and equipment. (MCW)

28791 (CONF-740215-1) ANL HIGH-ENERGY BATTERIES FOR ELECTRIC VEHICLES. Nelson, P. A.; Chilenskas, A. A.; Walsh, W. J.; Gay, E. C. (Argonne National Lab., Ill. (USA)). 1974. 18p. Dep. NTIS $3.00.

From 3rd international electric vehicle symposium; Washington, District of Columbia, USA (19 Feb 1974).

A program at ANL to develop batteries for use in electric automobiles and in electric utilities is described. Discussions and data are included on the need for electric cars, battery performance objectives, battery design, experimental results, and plans for transfer of battery technology to industry. (JRD)

28792 (LA-UR-73-1695) ARTIFICIAL GEOTHERMAL RESERVOIRS IN HOT VOLCANIC ROCK. Aamodt, R. L. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 13p. (CONF-740209-1). Dep. NTIS $3.00.

From U. S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Some recent results from the Los Alamos program in which hydraulic fracturing is used for the recovery of geothermal energy are discussed. The location is about 4 kilometers west and south of the ring fault of the enormous Jemez Caldera in the northcentral part of New Mexico. It is shown that geothermal energy may be extracted from hot rock that does not contain circulating hot water or steam and is relatively impermeable. A fluid is pumped at high pressure into an isolated section of a wellbore. If the well is cased the pipe in this pressurized region is perforated as it is in the petroleum industry, so that the pressure may be applied to the rock, cracking it. A second well is drilled a few hundred feet away from the first. Cold water is injected through the first pipe, circulates through the crack, and hot water returns to the surface through the second pipe. Results are described and circumstances are discussed under which artificial geothermal reservoirs might be created in the basaltic rock of Hawaii. (MCW)

28793 (NP-19963) CLEAN ENERGY FROM COAL: A NATIONAL PRIORITY. 1973 Annual Report, Calendar Year 1972. (Department of the Interior, Washington, D. C. (USA)). 1973. 124p. GPO $2.35.

The discussions consider energy to include fuel for heating, industrial processes, buildings, and homes; fuel for railroads, aircraft, and automobiles; and all uses of electricity that for the next 30 years will be generated substantially through burning fossil fuels. Environmental factors as they relate to the provision of clean energy fuels are discussed. New improved mining technology is necessary. The research programs being carried out by the OCR include pipeline quality gas; low-Btu fuel gas and electric power generation; and low-sulfur liquid fuels. The supporting research projects and their locations are presented. Some administrative, committee, patent, index, and report number data are included. (MCW)

28794 (ORNL-TM-4300) MULTI-UNIT POWER PLANT COST MODELS FOR THE CONCEPT CODE. Bowers, H. I.; Dudley, I. T. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 83p. Dep. NTIS $6.25.

Revisions to the cost models used by CONCEPT II that extend the capabilities of the code are described. The revisions include multi-unit cost models for PWR, BWR, coal, and oil plants that have been developed and added to the CONCEPT code. Cost models for wet limestone scrubbing sulfur oxide removal systems have been added as options to both coal and oil plants. Also, a first-unit cost model for a gas-fired plant has been developed and added to the code. All of these modifications have been included in CONCEPT III to make it capable of providing detailed estimates for each unit of a multi-unit plant and for the total plant. The cost models reflect design and construction experience for plants nearing completion in early 1971. (auth)

28795 (PB-207517) U. S. ENERGY PROBLEM. Volume I. Summary. (InterTechnology Corp., Warrenton, Va. (USA)). Nov 1971. 83p. (NSF-RANN-71-1-1). Dep. NTIS $4.85.

For National Science Foundation, Washington, D. C.

A summary is presented of a study to guide choice of priorities in energy-related research and development offered for government support. Major outputs are a detailed costing, modeling, and the determination of the influence coefficients of technologies on the cost of energy, primarily electricity. The status and probable trends of important elements in the energy economy are presented, as well as the state of the art and the economics of various alternative means of energy conversion. (auth)

28796 (PB-207518) U. S. ENERGY PROBLEM. Volume II. Appendices, Part A. (InterTechnology Corp., Warrenton, Va. (USA)). Nov 1971. 744p. (NSF-RANN-71-1-2). Dep. NTIS $12.50.

For National Science Foundation, Washington, D. C.

The appendix to NSF-RANN 71-1-1 includes research data on Energy Status and Outlook for U. S. and World; Simulation Model of Fossil-Fuel Steam Electric Generating Plant (including cost tradeoff analysis, influence coefficients, and cost reduction vs. technology); cost of fossil fuels; MHD topping; nuclear energy; residential energy analysis; and solar energy. (auth)

28797 (PB-207519) U. S. ENERGY PROBLEM. Volume II. Appendices, Part B. (InterTechnology Corp., Warrenton, Va. (USA)). Nov 1971. 685p. (NSF-RANN-71-1-3). Dep. NTIS $12.50.

For National Science Foundation, Washington, D. C.

The research data are summarized on off-peak power storage (including gas compression, water pumping, electrochemical, and others); state of electrochemical R & D; fuel cells; alternate energy conversion cycles; effects of failures of cryogenic superconductivity on electrical transmission lines; transportation; environmental factors; future investment capital for U. S. public utilities; supply-demand analysis for energy-related minerals; an econometric model for the primary copper, lead, zinc, and aluminum industries; the technology of alternative fuels; a petroleum refinery model; and the current state of thermionic energy conversion technology. (auth)

28798 (PB-221405-4) CHEMICAL DESULFURIZATION OF COAL: REPORT OF BENCH-SCALE DEVELOPMENTS. Volume 1. Final Report. Hamersma, J. W.; Koutsoukos, E. P.; Kraft, M. L.; Meyers, R. A.; Ogle, G. J. (TRW Systems Group, Redondo Beach, Calif. (USA)). Feb 1973. Contract EHSD-71-7. 184p. NTIS $6.00.

Bench-scale and laboratory tests were conducted for chemical removal of sulfur (S) from coal to produce a low sulfur coal to meet air quality standards. The method used was the Meyer's process in which pyritic sulfur is oxidized by ferric compounds to a water soluble form. Approximately 100% of pyritic S was removed, using aqueous ferric salt solutions which, for the four coals tested, corresponded to an absolute removal of 1 to 3.5% by coal weight of S. The heat content of the coal increased and the ash content decreased as a result of pyrite removal. The pyritic S was removed from the coal as elemental S (40 mole %) and iron sulfate (60 mole %). Process operating temperatures of 50 to 130C, pressure of 1 to 10 atm, residence times of 1 to 16 hrs, and coal top sizes from ¼-in. to 100 mesh were evaluated. Preliminary process design and cost estimation for a 100-ton/hr coal desulfurization plant are given. (GRA)

28799 (PB-221406-2) CHEMICAL DESULFURIZATION OF COAL: REPORT OF BENCH-SCALE DEVELOPMENTS. Volume 2. Final Report. Hamersma, J. W.; Koutsoukos, E. P.; Kraft, M. L.; Meyers, R. A.; Ogle, G. J. (TRW Systems Group, Redondo Beach, Calif. (USA)). Feb 1973. Contract EHSD-71-1. 86p. NTIS $4.85.

Computer programs for analysis of leach processes, laboratory experimentation, and data tables are given for the Meyers process applied to the desulfurization of coal. (GRA)

28800 (PB-221659-6) ASSESSMENT OF SOLAR ENERGY AS A NATIONAL ENERGY RESOURCE. Donovan, P.; Woodward, W.; Cherry, W. R.; Morse, F. H.; Herwig, L. O. (Maryland Univ., College Park (USA). Dept. of Mechanical Engineering). Dec 1972. 85p. NTIS $2.75.

Solar energy is received in sufficient quantity to make a major contribution to the future U. S. heat and power requirements. There are numerous conversion methods by which solar energy can be used for heat and power, e.g., thermal, photosynthesis, bioconversion, photovoltaics, winds, and ocean temperature differences. There are no technical barriers to wide application of solar energy to meet U. S. needs. The technology of terrestrial solar energy conversion has been developed to its present limited extent through very modest government support and some private funding. For most applications, the cost of converting solar energy to useful forms of energy is now higher than conventional sources, but due to increasing prices of conventional fuels and increasing constraints on their use, it will become competitive in the near future. Recommendations are discussed. (GRA)

28801 (PB-223138-9) RESIDENTIAL ENERGY CONSUMPTION VERIFICATION OF THE TIME-RESPONSE METHOD FOR HEAT LOAD CALCULATION. Anderson, R. W. (Hittman As-

sociates, Inc., Columbia, Md. (USA)). Jun 1973. Contract HUD-H-1654. 23p. NTIS $2.75.

The time-response method for calculating residential heat-loads was experimentally verified using several occupied single-family residences. Calculated and measured heating requirements were compared on an hourly basis and for a 34-day test period. The results of the study demonstrated the applicability of the time-response method for calculating residential heat loads for occupied residences having average quality of construction and lifestyle patterns of the occupants. (GRA)

28802 (PB-223536) PROCEEDINGS OF THE SOLAR HEATING AND COOLING FOR BUILDINGS WORKSHOP, WASHINGTON, D. C., MARCH 21–23, 1973. Part I. Technical Sessions, March 21 and 22. Allen, R. (ed.). (Maryland Univ., College Park (USA). Dept. of Mechanical Engineering). Jul 1973. 234p. (CONF-730350-P1). Dep. NTIS $3.00.

From proceedings of the solar heating and cooling for buildings workshop; Washington, District of Columbia, USA (21 Mar 1973).

For National Science Foundation, Washington, D. C.

The Solar Heating and Cooling for Buildings Workshop reviewed the status of solar energy for U. S. building applications as of March, 1973. Thirty-six technical papers were presented. Sessions were held on solar collectors, energy storage, domestic hot water heating, energy conservation and insolation, solar air-conditioning, and building systems for solar heating and cooling. Some foreign activities were also reviewed. The papers covered proposed research and proposed systems, as well as on-going research and existing operating systems. (auth)

28803 (PB-223995-2-GA) MODEL FOR DETERMINATION OF OPTIMAL ELECTRIC GENERATING SYSTEM EXPANSION PATTERNS. Final Report. Farrar, D. L.; Woodruff, F. Jr. (Massachusetts Inst. of Tech., Cambridge (USA)). Feb 1973. 208p. NTIS $5.50.

Long-range electric generating capacity expansion planning requires consideration of a diverse range of issues. To determine the optimum system expansion plan, it is necessary to create a synthesis of combinations of possible technical alternatives, observe the intertemporal effects of the system along the dimensions of the problem, and choose the set of alternatives that best meets the objectives while satisfying all constraints. A system of integrated techniques and computer codes has been formulated to evaluate the economic, environmental, and reliability aspects of regional generation expansion strategies. The computer codes comprising the model are used serially and in an iterative manner to find the set of plant and site alternatives and corresponding plant operating histories that will minimize the total present worth of all capital, operating and fuel costs while satisfying the demand for electricity, fuel and site availability, pollution limits, and reliability constraints. Prototypical versions of the 3 major submodels of the GEM exist; initial testing of the capabilities and sensitivities of the first two sub-models and their interface is currently being performed. (GRA)

28804 (PB-224005-9-GA) ESTIMATION OF AGGREGATE MILES OF EHV TRANSMISSION LINE NEEDS. Markel, L. C. (Massachusetts Inst. of Tech., Cambridge (USA)). Aug 1972. 163p. NTIS $4.75.

Regression analysis is used to develop models for the total number of miles of EHV line needed in a power system. The models developed are not meant to be used to design a transmission system, but to examine existing EHV systems to see if general patterns of relationships exist on a system-wide basis. Regional US data and projections of load and generation characteristics for the years 1960 to 1990 are used to develop regression models for circuit miles and gigawatt equivalent miles of EHV transmission line. F and t tests are used to determine the statistical significance of the model parameters. Methods of using the models to investigate the effect of new plant siting strategies or environmental constraints on EHV grid size are discussed. (GRA)

28805 (PB-224045-5-GA) MODELING OF ELECTRIC POWER DEMAND GROWTH. Final Report. Woodard, J. B. Jr.; Baughman, M. L.; Schweppe, F. C. (Massachusetts Inst. of Tech., Cambridge (USA)). Feb 1973. 20p. NTIS $3.00.

The development of a model is described for growth in demand for electric power. The emphasis is to develop a mathematical model that can be used for the analysis of detailed questions, such as: How will changes in air conditioning power demand, electric rate structures, population, etc., affect the daily load shapes (MW vs time) as well as the peak power and the overall electric energy consumption. Detailed answers to these questions are needed for generation planning of capacity and plant mix (nuclear, fossil, and pumped-hydro) as well as for the evaluation of the resulting environmental and economic impacts. These issues require detailed models combining economic models with engineering considerations affecting the dynamics of load behavior. Modeling of this kind can be limited by the data available, and an important aspect of this effort is to identify the data required for a detailed understanding of the load. The approach to be employed is a combination of state space dynamic models driven by stochastic processes with econometric models. (GRA)

28806 (PB-224061-2-GA) ECONOMIC–ENVIRONMENTAL–SECURITY TRANSFORM CURVES OF ELECTRIC POWER SYSTEM PRODUCTION SCHEDULES AND SIMULATIONS. Final Report. Gruhl, J. (Massachusetts Inst. of Tech., Cambridge (USA)). Nov 1972. 93p. NTIS $3.75.

A quasi-optimal technique, realized by a dynamically evolving mixed integer program, is used to develop regional electric power maintenance and production sample schedules, as well as unit commitment sample schedules. The scheduling mechanisms are used to display the tradeoffs that exist between the economic costs, environmental consequences, and reliability levels of all possible optimum strategies. Specifically hypothesized expansion plans are also tested on different possible future load demand curves. The results of this project show that a great amount of flexibility is available to both the operations scheduler and the system expansion planner, and that dollar costs, water and air pollution impacts cover a very wide range of consequences. These results also show that it is probably very wasteful to operate or plan a system using any single-minded measure of desirability as a decision-making strategy. (GRA)

28807 (PB-224119-8-GA) ASSESSMENT OF SO_2 CONTROL ALTERNATIVES AND IMPLEMENTATION PATTERNS FOR THE ELECTRIC UTILITY INDUSTRY. (Hittman Associates, Inc., Columbia, Md. (USA)). Mar 1973. Contract OST-40. 145p. (HIT-550). NTIS $4.50.

Four cases were investigated with the computer model developed by Hittman Associates to determine the nature of implementation plans for sulfur oxide control at the regional and national levels. In 1975 demand for low sulfur fuels will have exceeded the available supply. The four cases studied will achieve compliance with the state and federal emission regulations by 1986 (one by 1983). All are based on the timely development of solvent refined coal and the availability and utilization of alternative stack gas cleaning and control processes. Control alternatives are summarized and discussed including nuclear power and other advanced energy conversion systems such as hydroelectric and geothermal. (GRA)

28808 (TID-26534) RESIDENTIAL ENERGY CONSERVATION. Moyers, J. C. (Oak Ridge National Lab., Tenn. (USA)). 1973. 10p. Dep. NTIS $3.00.

One-third of the total electrical sales in the U. S. went to residential users in 1970. Refrigeration, water heating, space heating, and air conditioning are used most extensively in that order. An all-electric home energy consumption breakdown was made. The performance of heat pumps was computed for Atlanta, Philadelphia, and Minneapolis. The efficiency of window air conditioners was studied. The overall economic data are computed involving properly installed insulation. (MCW)

28809 (UCID-16455) STRATEGIC STORAGE, SUPERPORTS AND SALT DOMES: A SYNTHESIS. Palmieri, T. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Feb 1974. Contract W-7405-eng-48. 26p. Dep. NTIS $3.50.

In the U. S., there is a bill before the Senate that would establish emergency reserves of petroleum to sustain the country for at least 90 days. Storage of such reserves would be costly. If salt domes were leached to provide capacity for storing petroleum for a 90-day requirement, each facility would be about 8 million dollars, pipelines another 5 million, and the cost of the oil unknown. The arrival of large tankers involves the construction of superports to accommodate them. The proposed Texas superport will include a tank farm that will cover 100 acres. The site of the proposed superport in Louisiana is in the middle of a large field of salt domes. The import situation is discussed and recommendations to alleviate the worsening situation are listed. (MCW)

28810 (UCRL-51533) SHALLOW SOLAR POND ENERGY CONVERSION SYSTEM: AN ANALYSIS OF A CONCEPTUAL 10-MWe PLANT. Clark, A. F.; Day, J. A.; Dickinson, W. C.; Wouters, L. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jan 1974. Contract W-7405-eng-48. 30p. Dep. NTIS $4.00.

A shallow solar pond system appears to be the most cost effective way to produce large scale electric power from solar energy. Water is used both for heat collection and heat storage. Inexpensive layers of weatherable transparent plastic over the water suppress heat loss to the environment. The hot water is

stored in an insulated reservoir at night and during bad weather. The stored hot water heats a thermodynamic fluid, such as Freon 11, which drives a turbine and an electric generator. A shallow solar pond system can be built using materials, fabrication techniques, and geometries that are presently used on a large scale in U. S. industry. A 10 MWe plant built in the Southwest would require a total area of about 2.5 km^2 (~1 mi^2) and could provide power for a community or a manufacturing process. The estimated busbar cost of electricity (in 1973 dollars) for a shallow solar pond system, which could come on line in as short a time as 5 to 7 years, is 27 mills/kWh. It is projected that this cost could be reduced by almost half with the development of improved and cheaper plastics and more efficient turbines. (auth)

28811 REFRACTORIES INDUSTRY: ITS RELATIONSHIP TO THE U.S. ECONOMY AND ITS ENERGY NEEDS. Ayers, R. F.; Barr, H. W. Jr.; Fisher, W. H.; Duckworth, W. H.; McCoy, L. G. (Battelle Columbus Labs., OH). Amer. Ceram. Soc. Bull.; 53: No. 3, 220-223(Mar 1974).

Using a 127 by 127 sector input-output matrix, it was determined mathematically that: 1) the refractories industry has a direct or indirect impact on every other sector of the industrial complex, 2) each dollar of refractories output supports $1266 of GNP, and 3) the least damage to GNP occurs when energy supplies are allocated to industry in an evenhanded, nondiscriminatory fashion. (4 tables) (auth)

28812 FEASIBILITY OF SOLAR HEATING AND COOLING OF BUILDINGS. Weinstein, A.; Chen, C. S. Prof. Eng.; 44: No. 2, 28-32(Feb 1974).

The assurance of the availability of solar energy makes that factor more dominant than initial costs now. The concept for the utilization of solar energy is not new, but what is new is the development of systems, subsystems, and components of adequate performance and reliability that could be produced in volume at acceptable costs to meet the potential needs of a commercial market. Systems being developed for heating and cooling are discussed. Feasibility studies results will be presented in May 1974 for "proof-of-concept" experiments of sufficient scale in various building types and several regions of the country. (MCW)

28813 ACTIVATED EXTRACTION OF COAL USING A HYDROGEN-DONOR SOLVENT. Anderson, L. L.; Shifai, M. Y.; Hill, G. R. (Univ. of Utah, Salt Lake City). Fuel; 53: No. 1, 32-37(Jan 1974).

The kinetics of the extraction of a high-volatile bituminous coal with 1,2,3,4-tetrahydronaphthalene (tetralin) under the influence of ultrasonic energy has been studied at five temperatures: from 47 to 87°C. The effects of intensity of ultrasonic energy, particle size, and hydrogen content of the coal were also recorded. Analysis of the results showed that a second-order reaction followed by a first-order reaction best describes the kinetics of the extraction process. The enthalpies of the second-order and first-order regions were respectively 8.7 and 2.5 kcal/mol, suggesting essentially physical control. The entropies were respectively -44 and -70 e.u. Auxiliary experiments and the kinetic data obtained suggest a model for the extraction process. The mechanism of the overall reaction is undoubtedly complex, but the data indicate that van der Waals and hydrogen-bonding forces are most affected by the ultrasonic energy, although stronger bonding is also affected giving much higher yields than would be expected. From the yields obtained it is concluded that ultrasonic energy acts by rupturing bonds that are not affected by the solvent alone; the bonds affected are either strong hydrogen bonds or aliphatic covalent bonds, but not aromatic bonds. 25 references. (auth)

28814 DOUBLE VOLTAGE AND AMPACITY WITH SAME TOWER LOADING. Sherry, C. A. (Virginia Electric and Power Co., Richmond). Elec. Light Power, T/D Ed.; 51: No. 20, 76-78(Oct 1973).

A new conductor was installed across the James River by Virginia Electric and Power Company utilizing the 323-ft towers built in 1940. The new conductor was a 874.5 Kcmil 54/7 steel supported aluminum conductor that would operate at 189°C when the two bundled 721 Kcmil ACAR was operated at 90°C. This provided the necessary 1632 ampere capacity (single circuit) while maximum sag did not exceed the 1033.5 Kcmil ACSR previously considered at 90°C with about the same relative design tensions. The properties of the new conductor are discussed. (MCW)

28815 GREEN RIVER SHALE-OIL YIELDS: CORRELATION WITH ELEMENTAL ANALYSIS. Cook, E. W. (Rocky Flats Research Centre, Golden, CO). Fuel; 53: No. 1, 16-20(Jan 1974).

A rapid and practical test for oil-shale richness is of considerable technical importance. Although the Fischer-Schrader method has gained universal acceptance for determination of shale richness, there is need to relate results from this determination to fundamental parameters of the shale. One much-used relation is with elemental analysis, and numerous equations have been derived to correlate shale richness with organic carbon content. These relations have been reviewed, and from a number of intensively analysed samples selected from a coring in the Parachute Creek member of the Green River Formation equations relating oil yield by Fischer-Schrader determination to organic carbon content have been developed: oil (wt %) = $0.8317(\%C_{org}) - 0.2509$ and oil (gal/ton) = $2.216(\%C_{org}) - 0.7714$. Additionally, more detailed knowledge of the uniformity of organic material throughout the Green River Formation was obtained. It was found that the fraction of kerogen which on pyrolysis yields liquid products is constant stratigraphically throughout the formation, even though the oil composition is not. 26 references. (auth)

28816 OXIDATION OF BITUMEN IN RELATION TO ITS RECOVERY FROM TAR-SAND FORMATIONS. Moschopedis, S. E.; Speight, J. G. (Research Council of Alberta, Edmonton). Fuel; 53: No. 1, 21-25(Jan 1974).

Simple chemical reactions are described that bring about modification of the components of a bitumen. This is accomplished by using an oxygen-containing gas and subsequent treatment with alkali solutions of sulfites and/or bisulfites. The resulting water-soluble sulfonated bituminous derivatives have significant emulsifying and dispersing powers and are likely to be of use in extracting the bitumen in situ. (auth)

28817 HVDC: VALID AID FOR A-C TRANSMISSION. Marks, J. A. (ed.). Elec. Light Power, T/D Ed.; 51: No. 20, 43-47(Oct 1973).

More dc projects will be commissioned in the future mainly due to the high value placed on the environment. Strides have been achieved in valve technology, in station size reduction, and in simplicity. The justifications for dc transmission are long distance, bulk transmission for economy; stabilizing links between pools; and high capacity underground links. A dc link can reliably mitigate ac transient disturbances that might ripple from one ac system to another. Dc by its nature limits growth of a system short circuit on duty, which is a bigger problem every day in densely loaded systems. Oscillating disturbances on large regional interconnections can be damped by programmed control of dc flow on a link between pools. Some new domestic applications of long-distance dc transmission are sited, namely, the Basin Electric Power Co-op of Bismarck, N. D.; Tri-State G & T Assoc. of Denver; Square Butte HVDC, the second to use solid state valves in North America; and the 1100-mile HVDC project in the Republic of Zaire, central Africa. The problems facing dc breakers are for a method to drive current to zero under constant voltage, and for absorption of magnetic energy stored in the system. (MCW)

28818 RESEARCH ON UHV TRANSMISSION NEARS COMPLETION OF SINGLE-PHASE TESTING AT 1000 TO 1500 kV. EEI (Edison Elec. Inst.) Bull.; 41: No. 4, 190-192(1973).

Bundles of 4, 6, 8, 10, and 12 conductors were tested, using a single-phase overhead test line energized by means of a single-phase bus, which includes a 1500-Kv single-phase 33-Mva autotransformer, a lightning arrester, a precision SF_6-insulated capacity, and a coupling capacitor for radio-noise measurements. The test line was energized in March 1970 and was used to determine corona performance of many different bundle conductors. Audible noise, radio noise, and corona loss were measured under varying weather conditions. Two test cages were used for investigations of audible noise, radio noise, corona loss for different conductor bundle configurations, and conductor bundles for voltages up to 1500 Kv. Proposals are made for line performance measurements on a three-phase basis from 1974 to 1976. (MCW)

28819 HVDC AT SQUARE BUTTE EXTENDS SOLID-STATE EXPERIENCE. Ryder, F. (New Brunswick Electric Power Commission, NJ); Marchetti, R.; Fink, J. L. Elec. Light Power, T/D Ed.; 51: No. 20, 50-51(Oct 1973).

The Square Butte project will be rated at ±250 kV dc 1000 amps. The 500-Mw system will interconnect the power generating complex Center, ND, near Bismarck, with Duluth, MI, a distance of 456 miles. The project is scheduled for commercial operation in May of 1977. Design work is now underway for the terminal equipment. The system will be bi-polar, with provision for metallic return in case of a prolonged outage of one pole. Filters are divided so that one pole can be operated independently of the other, and valve groups are connected in the 12-pulse arrangement,

thus minimizing harmonic generation and reducing the size of the required filters by nearly two to one. Comparisons are made with the Eel River asynchronous tie. Simplification at Square Butte eliminates synchronous condensers. Solid state valves are employed and do not require external damping circuits as in the case with mercury-arc. (MCW)

28820 CLEAN ENERGY VIA CRYOGENIC TECHNOLOGY. Williams, L. O. (Martin Marietta Aerospace, Denver). Advan. Cryog. Eng.; 18: 502-524(1973).

From cryogenic engineering conference; Boulder, Colorado, USA (9 Aug 1972). CONF-720803-.

A review of H_2 fuel technology is presented. Discussions are included on power production, thermonuclear reactors, fission reactors, proposed energy systems, H_2 fuel use, safety considerations, use of by-product O_2, nuclear waste disposal, implementation flowsheets for H_2 use, economics, and thermal pollution. (JRD)

28821 ENVIRONMENTAL DESIGN OF BEAR SWAMP PROJECT. Kwiatkowski, R. W. (Charles T. Main, Inc., Boston); Pierce, L. D. J. Power Div., Amer. Soc. Civil Eng.; 99: No. PO1, 205-215(May 1973).

The civil engineering design of the Bear Swamp pumped storage hydroelectric project required cognizance of the effect upon environment along each stage of the major design decisions. Final configurations and treatment of reservoir slopes, borrow areas, surface features and recreational facilities took into account the impact of cost as well as potential detrimental effect upon both the immediate and the areal vicinity. After a brief project description, selection of the underground powerhouse is explained followed by a description of the considerations behind the location and procedure for the exploratory adit. Details aimed at preventing any future oil contamination of the reservoir by transformer accident are illustrated. The exterior architectural treatment of the two small power plants, which are integral parts of the project, is related to the environment from the standpoint of blending into the surroundings. Finally, the effect upon the Deerfield River and construction limitations are touched upon. (auth)

28822 LUDINGTON PUMPED STORAGE PROJECT. Comninellis, E. (Ebasco Services Inc., New York). J. Power Div., Amer. Soc. Civil Eng.; 99: No. PO1, 69-88(May 1973).

The Ludington pumped storage project, when completed at the end of 1973, will have a 1,872-Mw installed capacity. The upper reservoir with 53,000 acre-ft usable vessel is formed by a 6-mile long earth-fill dam with a sandwich type asphalt facing. The six penstocks are encased in concrete, under the embankment, and buried in silty sand on the slope. At the intake structure the gates are suspended by hoists that allow for fast emergency closure. A prestressed, precast, concrete baffle wall serves as vortex suppressor and ice barrier. The intake apron, with splitter walls is an energy dissipator for the pumped water energy. The powerhouse, constructed on clay, is protected by a breakwater and two jetties. The 6-312-Mw units are remotely operated and are started in pumping by the synchronous back-to-back method and pony motor. (auth)

28823 GEOTHERMAL OPERATING EXPERIENCE AT GEYSERS POWER PLANT. Matthew, P. (Pacific Gas and Electric Co., San Francisco). J. Power Div., Amer. Soc. Civil Eng.; 99: No. PO2, 329-338(Nov 1973).

Operating experience over 12 yr at the Geysers Power Plant has demonstrated that geothermal electric power generation can be reliable and economical. Location, terrain, environment, personnel considerations, and operating requirements have created new and unique problems compared with traditional thermal power generation practices. Common interests and goals of the steam supplier and the power plant operator have resulted in their solutions. Much has been learned about the selection of equipment and materials that will be used to make future installations more reliable and perhaps reduce power costs. Similar to other means of generating electric power, geothermal generation has certain inherent attributes and liabilities but when viewed in proper perspective with objectivity is sound and economical. (auth)

28824 ELECTRICITY INDUSTRY HAS WORRIES: PROJECT MANAGEMENT HELPS. Neumann, J. C. (MacKinsey and Co., Dusseldorf). Brennst.-Waerme-Kraft; 25: No. 12, 459-464(Dec 1973). (In German).

The German electricity industry is at a turning point. It must carry on investing in step with the growth of electricity demand. Yet the cost increase for plants and materials can no longer be balanced by technological efforts. This development is a heavy burden on the profitability of the electricity supply undertakings (EVU), and it appears that it can only be balanced by repeated price increases for the current. This article is intended to prove that, if the ambitious aims of the next decade are to be mastered, the concept of control by project management has to be applied more effectively for securing a balanced financial development, for carrying out tremendous capital investments, and especially for improving the cooperation between the electricity supply undertakings, the authorities, and the manufacturing industry. (GE)

28825 KING COAL'S LAST CHANCE. Papamarcos, J. Power Eng.; 78: No. 3, 39-45(Mar 1974).

Nuclear power growth projections, labor problems, cheap gas, health and safety regulations, and environmental protection laws caused the coal industry to lag behind in exploration and the opening of new mines in the last few years. Uncertainties still prevail even when nuclear power plants were delayed and shortages and prices surged ahead for oil and gas. Mining methods are discussed in relation to prevailing environment and health regulations. The trend in energy consumption is toward reverting back to coal, but mines cannot be opened overnight, miners cannot be trained overnight. The industry faces critical shortages of mining materials, such as roof bolts, diesel oil, ammonium nitrate, electric cable, and machinery and replacement parts. Forecasts hold that an investment of about $30 billion is needed by 1985 for the coal industry to be reinstated. (MCW)

28826 LIQUID FUELS FROM COAL, 1972. Goldman, G. K. Chemical Process Review No. 57. Park Ridge, NJ; Noyes Data Corporation (1972). 233p. $36.00.

The conversion of coal to highest quality gasoline is now a technical feasibility. The economic difficulty exists in raising the hydrogen content from 5 wt % to about 14% for a typical gasoline. The chemical nature of coal is discussed. The book contains a collection of 101 U. S. patents categorized under the three processes: extractive conversion processes; hydrogenation processes; and carbonization processes. The patent literature covers a substantial amount of information not available in the journal literature. (MCW)

28827 CHEMICAL MINING OF COAL TO AVOID STRIPPING. Elliott, G. R. B. (Los Alamos Scientific Lab., NM). Environ. Lett.; 5: No. 1, 17-20(1973). (LA-DC-72-1502a).

If steam-oxygen mixtures replace the more customary air or oxygen feed gases for underground coal gasification, then the coal energy can be recovered with minimal environmental damage. Such chemical mining looks like an attractive alternative to strip mining. (auth)

28828 SOLAR HEATING AND COOLING DEMONSTRATION ACT OF 1973. Ninety-Third Congress, Second Session, Report No. 93-769. Washington, DC; Committee on Science and Astronautics (1974). 43p. GPO.

The bill provides for the United States to accomplish the demonstration of the practical use of solar heating technology in three years utilizing current technology, and to accomplish the research, development, and demonstration of the practical use of combined solar heating and cooling technology within five years. Background, explanation, legislative aspects, cost and budget data, and committee considerations are given. (MCW)

28829 LET'S REASSESS SCREW COMPRESSORS. Barker, P. K. Power; 119: No. 4, 76-78(Apr 1974).

Helical rotary compressors use either high-pressure halocarbon or ammonia refrigerants and are capable of compression ratios in excess of 18:1, and thus are able to operate at condensing temperatures of 125 to 130°F. The compressor finds applications in strictly air-cooled systems in the 100-to-500-ton range, and substantially higher tonnages in multiple units. Because of volume-ratio considerations at diminishing pressure differences between suction and head pressures, the BHP requirement will remain level or actually decline with a tonnage increase during ac operation at normal temperature ranges, but does not apply at medium- or low-temperature levels of operation. The screw compressor has the advantage of stable operation throughout the modulation range of its capacity control and unloading mechanism, which is continuously variable from 100% down to 10%. A diagram is shown in a key heat-recovery system utilizing the screw compressor. (MCW)

28830 FEDERAL ENERGY ADMINISTRATION. Hearings Before a Subcommittee of the Committee on Government Operations, House of Representatives, Ninety-Third Congress, First Session, on H. R. 11793. To Reorganize and Consolidate Certain Functions of the Federal Government in a New Federal Energy Administration in Order to Promote More Efficient Management of Such Functions, December 10 and 11, 1973. Washington, DC; Committees on Government Operations (1973). 307p. GPO.

The hearings were conducted to hear testimony to establish a Federal Energy Administration to provide an administrative mechanism for the emergency conservation measures and related emergency actions that will be authorized under separate legislation. The roles of the proposed FEA, ERDA, NEC, and DENR are clarified. Statements are presented from personnel in many energy-related fields). (MCW)

28831 COAL GASIFICATION: AN ALTERNATIVE IN CLEAN ENERGY PRODUCTION. Goodholm, P. R. Combustion; 45: No. 9, 6-11(Mar 1974).

From petroleum mechanical engineering conference; Los Angeles, CA (16 Sep 1973).

The energy supply situation existing today in the U. S. is examined. The natural gas supply is short, but with the utilization of the one remaining abundant energy resource, coal, shortages may be alleviated. A coal gasification plant is proposed to be built in the Four Corners Area of New Mexico and is under design. The Lurgi process used to gasify the coal, to be mined in near-by New Mexico, Utah, Colorado, Wyoming, Montana, and North Dakota, is described. Technical, environmental, and economical aspects of the plant design are presented. (MCW)

28832 NORTH SEA OIL: THE RACE AGAINST TIME. Swiss, M. Energy Int.; 11: No. 3, 13-16(Mar 1974).

The exploration and production of oil in the North Sea continue and the discoveries of oil already evaluated at the end of 1973 were expected to produce 75 million tons of crude annually by 1978, 150 million tons annually by 1980, and 200 million tons annually by 1985. These evaluations are dependent upon geological conditions, on development costs, and market needs and are subject to change. The economics and legal aspects of these oil fields are discussed. The activities of all the big oil companies in the North Sea fields are given. The weather halted pipeline work in the winter of 1973. (MCW)

28833 ENERGY POLICY FACES LIMITED CHOICES. Smil, V. (Univ. of Manitoba, Winnipeg). Energy Int.; 11: No. 3, 18-19 (Mar 1974).

The view is presented that there is no shortage of energy for future generations. Fossil fuels and nuclear fission are the two available alternatives to meet the needs presently. The reserves of hydrocarbons are in tars, sands, and shales, but availability hinges on technologies and immense capital outlays. Exhaustion of all recoverable stocks of crude oil and natural gas will be a relatively fast phenomenon. Fast breeder reactors, thermonuclear fusion, solar conversion, and geothermal energy are new rational options with limitations. Controlled fusion, while theoretically feasible, poses an array of problems. Time lags and difficulties accompany the implementation of new energy and energy-related technologies such as MHD, high-Btu coal gasification, and SO_2 removal. Self-burial for high-activity radioactive effluents, hydrogen for portable energy needs, or low thermal ocean differences for power generation are decades away. (MCW)

28834 ENERGY AND ECONOMIC GROWTH: HOW CLOSE THE RELATION. Dilloway, A. J. Energy Int.; 11: No. 3, 21-23(Mar 1974).

The parameters involving the determination of a country's economic health are varied. The primary or secondary energy usage could be used to calculate the per capita use. The GNP and primary energy use for the years 1963 and 1970 are tabulated for Turkey, Portugal, Greece, Italy, Netherlands, and Sweden. Energy use relative to the gross domestic product before the oil crisis for various sections of Europe are given for the year 1968 and a projection of the 1980-1982 period. The contrasting relationship between electric energy consumption, economic activity, and total use of primary energy for 1968 to 1980 is shown. (MCW)

28835 AUSTRALIA POISED FOR FOSSIL FUEL BOOM. Scott, W. E. Energy Int.; 11: No. 3, 27-28(Mar 1974).

Fossil fuels will dominate the energy consumption usage in Australia for years. Natural gas is expected to increase to 20.8% by the year 2000 from 4.5% presently. From 1971 to 2000, gasolines and other fuels should remain at about the same proportion of the total, middle distillates almost double from 20.6% to 40.6%, and the heavy fuels decline from 29.7 to 13% of the total requirement. Data indicate that by the end of the century petroleum fuels could exceed 2.3 million bbl/day. The consumption of wood, bagasse, hydroelectric power, brown and black coal are discussed. It is predicted that it is unlikely that nuclear power generation will take a major role in meeting Australia's energy requirements much before the year 2000, with a possibility of 15,000 MWe generating capacity by then. (MCW)

28836 PARITY FACTORS FOR COMPARING THE ECONOMICS OF PROJECTED POWER STATIONS. Oplatka, G. Combustion; 45: No. 9, 21-26(Mar 1974).

The introduction of parity factors allows rational treatment of the problems involved in cost-effectiveness studies of power stations or their components. If the thermodynamic parameters are altered, the capital equivalent of the change can be found with the aid of a parity factor—a kind of economic index. Two parity factors are presented, and their application is shown generally and by means of examples. (auth)

28837 TECHNOLOGY AND USE OF LIGNITE. Proceedings of a Conference Held at Bismark, North Dakota, May 12-13, 1971. Kube, W. R.; Elder, J. L. (comps.). Bureau of Mines Information Circular 8543. Washington, DC; Bureau of Mines (1972). 145p. GPO $1.50.

The proceedings at the symposium included the following papers: A Progress Report on coal mine health and safety; pipeline transport of "liquid" coal; liquefaction of lignite with carbon monoxide and water; use of western coal and air-water quality control; relationship of air quality measurements to criteria and emission standards; nitrogen oxides, sulfur oxides, and particulate control technology for fossil fuel combustion; low gas temperature solution to high resistivity ash problems; collecting fly ash from western low-sulfur coals; pilot study of electrostatic precipitation for removing fly ash at basin electric's Leland Olds Station; future energy supply: approaches and options; lignite and the cyclone burner in a new 235-Mw generating station, and detailed construction and equipment costs for the 235-Mw Milton R. Young Generating Station. (MCW)

28838 ENGINEERING GUIDELINES FOR TOTAL ENERGY ARE EVEN MORE VITAL DURING FUEL SHORTAGE. Kauffmann, W. M. Power; 119: No. 4, 73-75(Apr 1974).

Large total-energy facilities, from 3 to 20 MW in capacity, are studied, but the guidelines are applicable to small units also. Heat-balance analysis, fuel costs, load factor, load-profile match, and control-system design are engineering parameters for total-energy systems that will improve fuel economy. (MCW)

28839 CONSERVATION AND EFFICIENT USE OF ENERGY. Part 3. Joint Hearings Before Certain Subcommittees of the Committees on Government Operations and Science and Astronautics, House of Representatives, Ninety-Third Congress, First Session, July 11, 1973. Washington, DC; Committees on Government Operations and Science and Astronautics (1973). 697p. GPO.

A comprehensive statement was issued at the hearings on the conservation and efficient use of energy by the Chairman of the President's Council on Environmental Quality. After noting the extraordinarily rapid growth rate of energy use in the U. S., energy use trends, the environmental impact of energy use, comparative effects of electric power systems, options for reducing environmental impact, improving production efficiency, and conservation in transportation, in residential and commercial sectors, and in the industrial sector are discussed. Other conservationists from many other facets of industry made statements. It is indicated that the importance of energy conservation can only be fully grasped when the present rate of energy growth is projected into the future. (MCW)

28840 ENERGY REORGANIZATION ACT OF 1973. Hearings Before a Subcommittee of the Committee on Government Operations, House of Representatives, Ninety-Third Congress, First Session, on H. R. 11510. To Reorganize and Consolidate Certain Functions of the Federal Government in a New Energy Research and Development Administration and in a Nuclear Energy Commission in Order to Promote More Efficient Management of Such Functions, November 27, 28, and 29, 1973. Washington, DC; Committees on Government Operations and Science (1973). 426p. GPO.

The hearings were conducted and the advantages of the creation of an independent Energy Research and Development Administration (ERDA) are listed. Statements are included from nuclear scientists, geologists, economists, fossil fuel industrialists, environmentalists, government relations personnel, electric utilities personnel, space scientists, Friends of the Earth, Sierra Club, researchers, and members of the committee. (MCW)

28841 COAL POLICY ISSUES. Part 1. Hearings Before the Committee on Interior and Insular Affairs, United States Senate, Pursuant to S. Res. 45, a National Fuels and Energy Policy Study, Ninety-Third Congress, First Session, on the Present and Future Role of Coal in Future Energy Supplies, June 6, 7, and 8, 1973. Washington, DC; Committee on Interior and Insular Affairs (1973). 705p. GPO.

The hearings were conducted to assist members of the Committee on Interior and Insular Affairs of the U. S. Senate to understand the issues inherent in the formulation of a long-term national energy policy that assures the continued welfare of the nation, including balanced growth, safeguarding and enhancing

the quality of the environment, and national security. Statements were heard from university personnel, federal and state senators, utility personnel, environmental agencies, and many other contributors. Natural gas, tar sands, synthetic fuels, and nuclear power are discussed as options. Environmental considerations will be the key to the determination of the role of coal in the future energy supply pattern. Communications sent to industrial organizations by U. S. senators are published in which the companies were asked to submit views on coal policy issues. (MCW)

28842 COAL POLICY ISSUES. Part 2. Hearings Before the Committee on Interior and Insular Affairs, United States Senate, Pursuant to S. Res. 45, a National Fuels and Energy Policy Study, Ninety-Third Congress, First Session, on the Present and Future Role of Coal in Future Energy Supplies. Washington, DC; Committee on Interior and Insular Affairs (1973). 573p. GPO.

The hearings were conducted to assist members of the Committee on Interior and Insular Affairs of the U. S. Senate to understand the issues inherent in the formulation of a long-term National Energy Policy that assures the continued welfare of the Nation, including balanced growth, safeguarding and enhancing the quality of the environment, and national security. Statements concerning the present and future role of coal in future energy supplies are published from fuel company officials and governmental officials in answer to a questionnaire from committee members. Much information is included on the technology available to burn coal under environmentally acceptable conditions at cost levels competitive with other fuels in fluidized-bed furnaces. (MCW)

28843 PRESIDENTIAL ENERGY STATEMENTS. Printed at the Request of Henry M. Jackson, Chairman, Committee on Interior and Insular Affairs, United States Senate, Ninety-Third Congress, First Session, Pursuant to S. Res. 45, a National Fuels and Energy Policy Study. Washington, DC; Committee on Interior and Insular Affairs (1973). 112p. GPO $1.05.

A collection of the messages, statements, and speeches made by President Nixon on the energy issues are compiled and published for the use of Senators participating in the National Fuels and Energy Policy Study. (MCW)

28844 CLEAN CONVERSION OF COAL TO ELECTRIC POWER: A DOLLAR AND CENTS APPROACH. Ashworth, R. A.; Bolez, C. A. Pub. Util. Fortn.; 93: No. 6, 36-42(14 Mar 1974).

Direct combustion of coal in a conventional steam cycle with stack gas cleanup; direct combustion of coal in conventional cycles with fluid bed boilers; low Btu gas burned in conventional boilers and conventional combined cycles; low Btu gas from coal used in advanced combined cycles; and a coal extract residual fuel scheme are methods discussed for the conversion of coal to electric power in the near term. Costs of such technologies are examined and the view is presented that full-scale financial and manpower investments by industry, government, and private investors are necessary. (MCW)

28845 FEDERAL ENERGY ADMINISTRATION ACT (1973). Hearings Before the Committee on Government Operations, United States Senate, Ninety-Third Congress on S. 2776, to Provide for the Effective and Efficient Management of the Nation's Energy Policies and Programs, December 6 and 7, 1973. Washington, DC; Committee on Government Operations (1974). 284p. GPO.

Hearings were held on S2776, a bill to provide effective and efficient management of the Nation's energy policies and programs. The bill embodies the President's proposal to establish a new Federal Energy Administration which will be the principal organization within the Federal Government for the formulation and implementation of policies and programs designed to meet the energy crisis. This proposed new agency is expected to develop and integrate domestic and foreign policies relating to energy resource management; develop and implement programs for dealing with energy production shortages, such as fuel allocation, surcharges, and rationing; develop and implement voluntary and mandatory energy conservation programs and promote efficiencies in the use of energy resources; develop and promulgate energy price regulations; develop and recommend policies on import and export of energy resources; facilitate implementation of the President's program to develop the potential for energy self-sufficiency; collect, evaluate, assemble, and analyze energy information on reserves, production, and demand and related economic data; and work with industry, State, and local governments and the general public on energy resource management. (MCW)

28846 SOLAR HEATING DEVICE. Tarcici, A. (US Patent 3,797, 476. 19 Mar 1974. Filed date 19 Mar 1973. 6p.

A solar heating device is described comprising an upright tubular post, a rigid support protruding perpendicularly from the post, and a generally paraboloidal reflector having a rigid arm extending along the axis of the reflector from the center towards the focal point. A pivot perpendicular to a free end of the arm is selectively pivotally mounted and secured in one of a plurality of notches in the support to provide a compensation for the lateral displacement of the focal point as the reflector is tilted. A height adjustable grid mounted on a tube slidably received within the post enables the support of an object to be heated. A rod indicating the focal point of the reflector can be disposed along the axis. (auth)

28847 WIND TURBINE GENERATOR. Carter, F. H. US Patent 3,793,530. 19 Feb 1974. Filed date 19 Apr 1972. 6p.

An electric energy generator is described that is driven by a wind-actuated turbine rotor rotatably supported on a vertically disposed sleeve telescoped over and journaled on a rigid upright supporting post. The rotor includes a plurality of vertically disposed louvers capable of independent pivotal movement about a vertical axis at the inner edge thereof for orientation in radial relation to the rotational axis of the rotor or substantially tangential so that wind will effectively drive the rotor. The rotor is also provided with lift wings on the upper surface thereof that may include stabilizers and shock absorbers fastened to the edge of the wings and the outer edge of the louver support to support part of the load as the rotor whirls in the air providing a floating power device. A wing assembly, which may be hollow and filled with helium gas to reduce the load, is supported on the sleeve above the rotor and includes propeller assemblies mounted thereon to operate the rotor during periods of no wind or only a very slight wind. Governor control means is provided for selectively latching the louvers in tangential relation to the path of movement thereof to prevent the rotor from over-speeding during periods of high wind. Gear assemblies are provided for rotating generators to provide an electrical output that can be used for various purposes thereby utilizing the wind power to produce electrical energy that can be used for various purposes. (auth)

28848 APPARATUS FOR DRYING COAL. Kemmetmueller, R. (to American Waagner-Biro Co., Inc.). US Patent 3,793,743. 26 Feb 1974. Filed date 23 Aug 1972. 8p.

An apparatus is described for drying coal. The coal, in the form of coal particles, is fed into a drying chamber where the coal is suspended in a fluidized bed while being dried in an atmosphere of steam at a temperature too low to release oxygen but high enough to extract sulfur from the coal particles. The temperature of the atmosphere in the fluidized bed where the drying of the coal takes place in regulated with heating coils that directly contact the coal particles while the latter are suspended in the fluidized bed, so that further drying is achieved by direct contact between the coal particles and the heating coils. The coal with its reduced sulfur and moisture content is taken in a pre-heated condition from the dryer and delivered to a coke oven to reduce the extent to which coal must be heated therein. Gas extracted from the dryer is treated to have water condensed therefrom and to extract sulfur therefrom. In addition, pellets of calcium oxide and/or magnesium oxide are delivered to the fluidized bed together with the coal particles for further extracting sulfur from the atmosphere in the fluidized bed, these pellets also being subsequently treated, as by roasting, to extract sulfur. (Official Gazette)

28849 NEW EXOTIC ENERGY IDEA: SOLAR POWER FROM THE SEA. Elec. Light Power, E/G Ed.; 52: No. 5, 17-18(Mar 1974).

The solar power project aimed at generating electric power using ocean water temperature differences as an energy source is being funded primarily by NSF's RANN program. Electricity is generated by boiling a fluid at the temperature of water near the surface, then expanding the gas through turbine to drive a generator, then condensing the gas at the temperature of cold water from the depths. The sun, warming the surface water, is the free source; there is no fuel cost. The seapower plant is not affected by nighttime or cloud cover and the temperature difference remains constant, eliminating the need for energy storage. Due to a temperature difference of about 20°C, the thermal efficiency is only about 3 per cent. Schematics of the closed-cycle ocean thermal power plant and the Mark I prototype solar sea power plant are shown. (MCW)

28850 IS THICKER INSULATION YOUR POWER PLANT GLADWRAP. Elec. Light Power, E/G Ed.; 52: No. 5, 16-17 (Mar 1974).

Calculations for thermal insulation optimum thickness are discussed for components in the industrial plant. The six parameters that enter into the calculation of the most economic thickness of insulation are raw fuel costs, system thermal efficiency, cost of money, capital investment in the plant and

investment system, depreciation period, and the cost of maintaining the insulation system. (MCW)

28851 NEW ZEALAND'S CHALLENGE TO U. S.: WAIRAKEI. Wehlage, E. F. Geotherm. Energy Mag.; 2: No. 2, 12-17(Feb 1974).

The New Zealand Electricity Department controls the geothermal operations at Wairakei along with all other government owned power stations including the grid system for distributing electricity to the various supply authorities around the country. The Ministry of Works is in charge of the development of geothermal energy. A comparison of geothermal production in the U. S. and New Zealand shows interest in geothermal at about the same time in the two countries. If the U. S. had produced geothermal energy in relation to its size as that of New Zealand, and with population as a criteria, production in the U. S. shouls have totalled nearly 10,000 Mw to date rather than some 400 Mw. The engineering history of geothermal energy and the utilization of waste heat in New Zealand are discussed. (MCW)

28852 DECISION STATEMENT OF SECRETARY OF INTERIOR ON GEOTHERMAL RESOURCES PROGRAM. Morton, R. C. B. Geotherm. Energy Mag.; 2: No. 2, 22-24(Feb 1974).

The Secretary of the Interior determined to open all available Federal lands to leasing under the Geothermal Steam Act of 1970 and to promulgate geothermal resources leasing, operations, and unit regulations. The lands of known geothermal resources in the Clear Lake-Geysers area, the Mono Lake-Long Valley area, and the Imperial Valley were offered for competitive leasing on January 22, 1974. The limitations are outlined. (MCW)

28853 IMPERIAL VALLEY INVESTIGATIONS: UTILIZATION OF THE SODIUM-POTASSIUM-CALCIUM GEOTHERMAL EXPLORATION TECHNIQUE IN THE IMPERIAL VALLEY AREA, CALIFORNIA. Copien, T. B. (Univ. of California, Riverside). Geotherm. Energy Mag.; 2: No. 2, 32-34(Feb 1974).

The technique of Fournier and Truesdell's function was used to determine Na, K, and Ca concentrations of nearly 200 well water, spring water, hot spring, and geothermal fluid samples from the Imperial Valley area. It is shown that under favorable conditions Na, K, and Ca concentrations in natural waters may be used to predict the last temperature of water-rock equilibration and that most geothermal fluids plot near a straight line on a graph of the function $F(T) = \log (Na/K) + \beta \log\{\sqrt{(Ca)}/Na\}$ versus reciprocal of the absolute temperature. The value for beta is 4/3 unless equilibrated temperatures are above 100 C, in which case beta is 1/3. Lower values for F(T) indicate higher water-rock equilibration temperatures. F(T) values for 50, 100, and 200 C are approximately 2.6, 2.0, and 1.1 respectively. The geothermometer is a useful tool for predicting subsurface temperatures and for distinguishing the existence of a geothermal system at depth. (MCW)

28854 GREAT GREEN BOILER IN THE SKY. Russell, T. K. Geotherm. Energy Magn.; 2: No. 2, 35-48; 50-52(Feb 1974).

The Department of the Interior forecasts that the U. S. energy supply and consumption to the end of the century including the primary conversion of energy forms to secondary forms such as electricity and synthetic gas is expected to grow at an average rate of 3.6 percent at the expense of using up the fuel supplies too fast. With all energy development technologies lagging, an examination was made of geothermal energy with Planet Earth referred to as the great green boiler in the sky. Larderello's steam plants have been producing electricity since 1904. Development in other countries is reviewed and now the first contract has been established for Pacific Gas and Electric Company to begin building power plants at the Geysers. Eight units are installed and operating; during 1973, units 9 and 10, each with a net operating capacity of 53 Mw are expected to be installed and in operation. In 1973 an additional 106 Mw are expected; in 1975, another 106; in 1976, a unit of 110; and continuing development is planned. A description of the geothermal types is given. The technologies applied for the development of the Geysers and the accompanying power plants are discussed. (MCW)

28855 CONSERVATION GOAL MET BY POLLUTION-FREE INCINERATION, HEAT RECOVERY. O'Connor, J. J. Power; 119: No. 4, 62-63(Apr 1974).

A case is described in which coal-fired boilers were replaced by incinerators. Heat reclaimed serves to generate steam that heats ovens, platen presses, paper-machine dryer rolls, the plant, assorted processing equipment, and feeds turbine-driven paper machines. Liquid wastes are atomized and burned as fuel oil being sprayed into the combustion chamber as a fine mist. Solid wastes are burned in a double-vortex burner system. The conversion allows for yields of 160,000 lb of steam per hour and a clean stack. (MCW)

28856 ELECTRICITY SUPPLY IN SWEDEN, 1975-1990. 1972 Study. Stockholm; CDL-Foeretagens Samarbetsorgan (1973). 22p.

A history of the Swedish power production since 1934 when nine companies were organized as an emergency organization to produce electricity in time of war or threat of war is briefly described. Fourteen companies now transmit over the national grid and participate in the nationwide joint operations and are responsible for over 80% of power production. Electric power in relation to society, electricity consumption, advancement of technology involving nuclear power and its economics, electricity production, site selection, and some recommendations are discussed. (MCW)

28857 ENERGY POLICY. Dohmori, Y. (Japan Socialist Party, Tokyo). At. Jap.; 17: No. 4 Suppl., 43-47(Apr 1973).

From 6th annual conference of the Japan Atomic Industrial Forum; Tokyo, Japan (7 Mar 1973).

The energy policy involving nuclear power is given. With increasing national production, energy consumption is rising rapidly and energy policy changes must be made. Three major factors involved in the situation are the limits in natural resources, required environmental conservation, and the management of energy in a democratic way. For Japan, current energy consumption is excessive. The energy policy should be directed to the maintenance of natural environment, and the control as strict as possible of energy consumption. As the means in this direction, several propositions are made, including the limitation to energy-consuming merchandise, lengthening the life of industrial products, etc. (JA)

28858 COAL TECHNOLOGY: KEY TO CLEAN ENERGY. Annual Report 1973-1974, Office of Coal Research, U. S. Department of the Interior. Washington, DC; Department of the Interior (1974). 156p. GPO $2.20.

Demand for energy continues upward in the U. S. and with shortages of natural gas and oil, coal must now be converted to pipeline and low-Btu quality gas, both liquid and solid fuels, and methods found to burn it cleanly to produce electricity. Programs for development of new technology to ensure the full utilization of coal without polluting the environment are described. Power generation systems for increasing the efficiency of thermal to electric energy conversion are described including MHD generators and components. Supporting projects sponsored by the OCR are described. International activities, administration, patents, committees, and legislative data are included. (MCW)

28859 NATURAL GAS LEGISLATION. Ogden, W. J. Pub. Util. Fortn.; 93: No. 6, 20-24(14 Mar 1974).

Natural gas reserves are quite substantial, but the development of supplies has declined over the past few years. The pricing policy has been a significant factor, and revision of the regulated pricing is necessary. The legislative proposals considered essential are enumerated. Then the considerations for oppositions to deregulation of producer prices are discussed. Some other proposals include the establishment of a national exploration and development company, incremental pricing, and the use of natural gas pipelines as common carriers. (MCW)

28860 LEGISLATIVE GOALS OF ELECTRIC COMPANIES IN 1974. Toll, D. R. Pub. Util. Fortn.; 93: No. 6, 17-19(14 Mar 1974).

Federal policies, bills, and proposals in Congress of interest to the electric companies in helping to achieve national energy self-sufficiency are discussed. The view is presented that federal statutes and policies must be revised to encourage increased use of coal and nuclear power. Accelerated research to develop cleaner fuel and new sources of power is also seen to be a necessary goal. (SFL)

Information Handling

Refer also to abstract 28296.

28861 (ANL/ACC-1) ARGONNE CODE CENTER INSTALLATION REPRESENTATIVE GUIDE. (Argonne National Lab., Ill. (USA)). Jan 1973. Contract W-31-109-eng-38. 40p. Dep. NTIS $5.00.

The program and operating procedures of the Argonne Code Center are described. The activities of the Center are discussed in terms of the following: (1) information services, (2) program exchange, (3) ACCESS facilities, and (4) cooperative efforts. (MOW)

28862 (CEA-CONF-2503) ADVANTAGE OF DIALOG VISUALIZATION IN AUTOMATIC DOCUMENTATION. Coulomb, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France)). 1972. 9p. (In French). (CONF-7210113-2). Dep. NTIS (U.S. Sales Only) $3.00.

From meeting on visual display systems; Saclay, France (11 Oct 1972).

28863 (EP-RR-32, pp 153-169) DATA ACQUISITION AND HANDLING FOR PLASMA PHYSICS. Vance, C. F. Oct 1972.
From proceedings of the Canberra plasma physics seminar; Canberra, Australia (1972).
Modern views of scientific research, as the formulation of hypotheses and of experiments whose results could disprove them, are summarized. Effective research demands the speedy confrontation of data produced by theory and by experiment. To the extent that one of these sources produces more data than is quickly available from the other for comparison, one accumulates archives of dormant data, which soon become dead data if not used. Plasma physics, involving interactions between many rapidly changing variables, raises such data mismatch problems. The solution depends on the provision of greatly improved mechanized aids to research. Some data acquisition and retrieval methods, and possible computing facilities with on-line interactive displays are outlined. These could be linked together to enable the physicist to compare theoretical predictions with experimental results much more effectively than is at present possible. (auth)

28864 (EUR-5053) AUTOMATIC SUFFIX ANALYSIS. Pfeifer, M. (Commission of the European Communities, Luxembourg; Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Feb 1974. 106p. (In German). Dep. NTIS (U.S. Sales Only) $7.50.
Thesis. Submitted to Stuttgart Univ., Ger.
The present study describes methods of "Automatic Suffix Analysis" and, in particular, reviews the approach chosen in the previous experimental indexing project of CETIS. It contains a general mathematical representation of the problem using set-theoretical notations. Some examples found in the literature are discussed and an evaluation from the linguistical point of view is given. Finally, a machine program is described which is able to handle all different approaches found. (auth)

28865 (ORNL-TM-4320) SURVEY OF INFORMATION CENTERS HANDLING ENVIRONMENTAL INFORMATION RELATING TO RADIATION OR NUCLEAR POWER. Cottrell, W. B. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 41p. Dep. NTIS $4.25.
A survey was undertaken of some 169 environmental information sources listed in two compilations, to ascertain their relevance to radiation and nuclear power, as well as their users and type of information products. Of the 92 information sources responding to this survey, only 51 were deemed relevant and were included in this report. The significant characteristics of each of these 51 centers are tabulated and the results summarized. Services were available to each of five user classifications from over 90% of these centers and the available information types are quite varied. Fully one-third of the centers were charging for some of their services, and many others had the matter under consideration. (auth)

28866 (STI/DOC-11(Vol.11)(No.3)) LIST OF BIBLIOGRAPHIES ON NUCLEAR ENERGY. (International Atomic Energy Agency, Vienna (Austria)). Dec 1973. 19p.
The present volume of the List of Bibliographies on Nuclear Energy has been compiled from information made available by Member States and from sources indicated by them. The object is to disseminate information about bibliographies published or in preparation. The entries were classified by subject following the pattern adopted for the Agency's publication "Atomindex." Under each subject group the entries are arranged in alphabetical order, indicating the name of the organization which has compiled the bibliography. (MOW)

28867 (TID-4583) GUIDE TO ABSTRACTING AND INDEXING AT THE TECHNICAL INFORMATION CENTER. (USAEC Technical Information Center, Oak Ridge, Tenn.). Feb 1974. 66p. Dep. NTIS $5.45.
The Technical Information Center (TIC) of the AEC provides abstracts and indexes for the AEC publications Nuclear Science Abstracts (NSA) and Indexes of Limited Distribution Reports (ILDR). In addition, TIC provides abstracts and indexes for US-published information included in the International Nuclear Information System (INIS). TID-4583 contains the guidelines used in abstract writing and editing and in subject index construction. (auth)

28868 (TID-25710-R1) ANALYSIS OF WORLD-WIDE CONTRIBUTIONS TO NUCLEAR SCIENCE ABSTRACTS, VOLUMES 25(1971) AND 26(1972). Cape, J. D. (USAEC Technical Information Center, Oak Ridge, Tenn.). Feb 1974. 79p. Dep. NTIS $5.45.
The literature appearing in Nuclear Science Abstracts for the years 1971 and 1972 is analyzed in 3 tables, 22 figures, and 2 appendixes. The analysis includes the total number of literature items contributed, arranged by country of author affiliation and broken down into type of literature; the number of items in each NSA subject category contributed by each major contributing country of author affiliation; the percent of items in each NSA category contributed by the major contributors; bar charts of the number of items in each NSA category since 1950; and lists of journals with the number of items appearing in NSA arranged by country of journal publication and in order of decreasing number of items. (auth)

Law

Refer also to abstracts 27038, 28840, 28841, 28843, 28860, and 28888.

28869 (INIS-mf-1117, pp 33-35) NUCLEAR ENERGY AND LEGAL CONTROLS. King, B. D. 1973.
From 45th congress of Australia and New Zealand Association for the Advancement of Science; Perth, Australia (13 Aug 1973).
Legislation passed in Australia which controls the use of nuclear energy is discussed. Legal aspects discussed include the powers of the commonwealth government, licensing and nuclear insurance. A short account of the legislative experience of Western Australia is given. (AT)

28870 FEDERAL CHARTERS FOR ENERGY CORPORATIONS: SELECTED MATERIALS. Prepared at the Request of Henry M. Jackson, Chairman, Committee on Interior and Insular Affairs, United States Senate, Ninety-Third Congress, Second Session, Pursuant to S. Res. 45, A National Fuels and Energy Policy Study. Washington, DC; Committee in Interior and Insular Affairs (1974). 149p. GPO $1.35.
The requirement of Federal charters for large energy corporations, coupled with the appointment of public directors to serve on their boards, would make these corporations more responsive to the public interest. The large oil companies wield economic power greater than many governments by running vast production and refinery complexes, operating large tanker fleets, investing billions in resource development, and lastly, controlling the prices consumers pay for energy. Other alternatives for making the companies more responsive to public interest are to nationalize segments of the oil industry; create new federally owned oil companies; break major oil companies into functional components and/or regional components; bring major oil companies under a Federal regulatory structure that treats the corporation as public utilities, regulates rates on a cost of service basis, and makes them subject to control; or improve corporate accountability and responsibility by revising the hundreds of Federal statutes that now affect various aspects of corporate practice. A collection of relevant papers are included. (MCW)

28871 CURRENT PROBLEMS AND PRESENT STATE OF THE INTERNATIONAL NUCLEAR LAW. Pelzer, N. (Univ., Goettingen, Ger.). Energiewirt. Tagesfragen; 23: No. 12, 625-631(Dec 1973). (In German).
The subjects discussed at the "Nuclear Inter Jura 73" are reviewed. The conclusions arrrived at as regards public opinion and nuclear energy, environmental protection, the legal aspects of nuclear shipping, the Non-Proliferation Treaty, and changes undergone by the International Atomic Law are commented upon. (GE)

28872 NATIONAL ENERGY POLICY AND THE ANTITRUST LAWS. Kauper, T. E. (Dept. of Justice, Washington, DC). At. Energy Law J.; 15: No. 4, 265-279(Win 1974).
Antitrust law has a role to play in the current energy crisis. Competition as a means of bringing about efficiency and the inhibiting effects of regulation are emphasized, with examples drawn from the electric power field (Florida Power Corp. and Tampa Electric Co., Otter Tail Power Co.). Antitrust review to AEC when a reactor plant license is sought, is discussed and its beneficial effect illustrated with the example of Mississippi Power and Light Co. and its procompetitive arrangements. Deregulation of natural gas prices is also needed, with an accompanying increased role for the antitrust laws. Principles behind the lawsuits against dairy cooperatives are discussed. It is stated that anticompetitive state and federal regulation should be criticized carefully. (DLC)

28873 COMPETITIVE ISSUES RELATING TO ENTRY INTO THE URANIUM ENRICHMENT INDUSTRY. Kauper, T. E. (Dept. of Justice, Washington, DC). At. Energy Law J.; 15: No. 4, 280-300(Win 1974).
The views of the Department of Justice are given on: the desirability of new enrichment capacity being provided by private firms; methods through which the government can facilitate the private entry; and antitrust considerations. Pricing, price regulation, contractual arrangements, entry policy, and joint ventures are considered under the last topic. Different types of firms which

might raise competition problems are discussed by category: energy companies, equipment suppliers, and utilities. (DLC)

Management

Refer also to abstract 27038.

28874 PROTECTION OF WORKERS WITH RISKS OF IONIZING RADIATIONS IN THE NATIONAL HEALTH SERVICE. Pulcinelli, M. (Univ., Pisa, Italy); Strambi, E. Nuovi Ann. Ig. Microbiol.; 23: No. 3, 185-194(1972). (In Italian). (RT/PROT-(73)2).

Specific regulations for radiation protection now in force in Italy and International rules on this subject are reviewed. The responsibilities and necessary preparation of physicians (in order to become) qualified experts on radiation protection are discussed. It is proposed that radioprotection be included in the plan of national health service. (auth)

Mathematics and Computers

28875 (CEA-CONF-2357) APL INTERPRETER FOR MINICOMPUTERS: A MICROPROGRAMMED APL MACHINE. Amram, Y.; de Cosnac, B.; Granger, J. L.; Smoucovit, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France)). [nd]. 13p. (In French). (CONF-730853-1). Dep. NTIS (U.S. Sales Only) $3.00.

From APL conference; Copenhagen, Denmark (22 Aug 1973).

An APL interpreter implemented on mini-computers (MITRA-15, MULTI-20) is described. A left to right syntax analyzer is described which translates the external APL language to an internal codestring and also a recursive routine for generation and execution, that uses a beating method for the array processing. Moreover during the execution of all APL statements, dynamic memory allocation is used. (auth)

28876 (CEA-R-4438(E)) NEW METHOD FOR QUANTIFYING THE VALUE OF INNOVATIONS. Thiriet, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). Dec 1973. 36p. Dep. NTIS (U.S. Sales Only) $4.00.

The profitability of R and D/Innovation depends on the outcome of the various wagers necessarily made on the success of the different stages of R and D and, above all, on the market performance of the innovation. Some means of evaluating and minimizing these risks are required. The first part of the paper presents a numerical technique for evaluating the subjective probabilities of the principal random parameters and an aggregate probability model for forecasting returns using Monte-Carlo simulations. The second part examines the market penetration of the innovation, taking account of the projected evolution of the relevant sectors of economic activity, the likelihood of new substitutes coming onto the market, the possible reactions of competitors, etc. The proposed concept, a states of the market tree, is a probability-linked extension and a dichotomic systematization of G. Debreu's probability tree. It is developed into a qualitative and quantitative means of analysis, simulating prospective markets. (auth)

28877 (CONF-740113-1) REMOTE SERVICE ANALYTIC COMPUTING. Carter, H. P. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). [nd]. 7p. Dep. NTIS $3.00.

From secure automated computer network/management information systems conference; Washington, District of Columbia, USA (16 Jan 1974).

28878 (COO-2383-5) BATCH SYSTEM WITH RAPID OVERLAY CAPABILITIES. Mueller, D. H. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Dec 1973. Contract AT (11-1)-2383. 45p. (UIUCDCS-R-73-614). Dep. NTIS $4.25.

A batch supervisor for a minicomputer has been written which provides rapid sequencing between jobs. The supervisor can handle a small number of system programs, and also allows each system program to have a large number of overlays. Overlays are read into core rapidly, and the sequencing of overlays and job steps is very flexible. Finally, the supervisor is small, leaving most of the minicomputer's core storage to the system programs. (auth)

28879 (JINR-E4-7486) PERTURBATION THEORY FOR HAMILTONIANS OF ANDERSON AND HUBBARD TYPE. I. Realization of General Statistical Wick Theorem. Westwanski, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 22p. Dep. NTIS (U.S. Sales Only) $3.25.

Within a new perturbation theory, the Coulomb interaction is included into zeroth-order Hamiltonian. The realization of the general statistical Wick theorem is described in terms of eight-Fermi and four-spin type transverse operators. Diagrammatic representation of both transverse and diagonal operators is obtained. (auth)

28880 (SLA-73-5733) MAP-MATCHING ESTIMATION OF LOCATION, USING RANGE-SCAN RADAR IMAGES. James, L. T. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 7p. (CONF-740502-1). Dep. NTIS $3.00.

From national aerospace electronics conference; Dayton, Ohio, USA (13 May 1974).

28881 (SLA-74-5087) DEVELOPMENT OF SELF-CORRECTING RUNSTREAMS. Crompton, J. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 17p. (CONF-740210-1). Dep. NTIS $3.00.

From technical program-winter meeting; Los Alamos, New Mexico, USA (4 Feb 1974).

The concept of production control by START files is discussed along with aspects of checkpoint status reporting messages in dynamic run streams. The concept of embedded restart points and automatic jump to contingency paths, rerun paths, or alternate or backup recovery paths is developed and demonstrated. A higher degree of programming sophistication leading to self-diagnosing and self-healing run streams as in on-line systems is obtained. (auth)

28882 (TID-26533) LTSS: LIVERMORE TIME-SHARING SYSTEM. Part III. Problem Program Production. Chapter 207. LRLTRAN Language Used with the CHAT and STAR Compilers. Martin, J. T.; Zwakenberg, R. G.; Solbeck, S. V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Jul 1973. 201p. Dep. NTIS $12.25.

LRLTRAN, a programming language derived from FORTRAN, is the FORTRAN type language supported by the Laboratory's computation department. It contains most of the features of FORTRAN IV and, in addition, many unique features that warrant giving the language a unique name. The features include macro-processing (the calling of blocks of statements or statement skeletons into the program during compiling), bit and byte manipulation (for more efficient use of storage), program optimization, and vector extensions (through which strings of elements can be manipulated for more efficient use of central processing). (auth)

28883 (UCRL-51518) PARAMETERS THAT CHARACTERIZE THE NUMBER OF DEGREES OF FREEDOM IN TRUNCATED CHI-SQUARED FREQUENCY DISTRIBUTIONS. Perkins, S. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jan 1974. Contract W-7405-eng-48. 16p. Dep. NTIS $4.00.

The maximum likelihood method provides the best fitting value of the number of degrees of freedom for a family of truncated chi-squared distributions, based on a given set of measurements. This technique leads to the analytical description of certain parameters which need be calculated just once. These parameters are given in tables for easy comparison with experimental results, e.g., distributions of nuclear reaction widths. (auth)

28884 (Y-IA-122) PROGRAMMING MAINTENANCE REPAIR SHOP WORKLOAD FOR BOTH EMERGENCY AND ROUTINE DEMANDS. Gentry, D. H. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1974. Contract W-7405-eng-26. 21p. (CONF-740304-1). Dep. NTIS $3.25.

From plant engineering and maintenance conference; Cleveland, Ohio, USA (18 Mar 1974).

This paper discusses a general work control system concept which is in effect in the Maintenance Division of the Union Carbide Corporation Nuclear Division's Oak Ridge Y-12 Plant. Seven basic functions of work control are presented. From this point, the implementation of these steps in a repair shop to satisfy both emergency and routine demands is covered. Among the subjects discussed are work classification, determination of job priority, and effective use of preventive maintenance. The paper attempts to cover both what has been done in these areas and the reasons these items have been done as they are. (auth)

Miscellaneous

28885 (ANL/ES-28) HANDBOOK OF AIR POLLUTANT EMISSIONS FROM TRANSPORTATION SYSTEMS. Cirillo, R. R.; Wolsko, T. D. (Argonne National Lab., Ill. (USA)). Dec 1973. Contract W-31-109-eng-38. 180p. Dep. NTIS $12.00.

Procedures for estimating the rate of air pollutant emissions from transportation systems are described. Emission factors and computation techniques for motor vehicles, railroad locomotives, aircraft, and waterborne vessels are presented. The

major emphasis is on motor vehicle emission computations and data on model year emission rates, control device deterioration, and vehicle speed adjustments are given. Procedures for separating the cold start, computing evaporative emissions by source, and developing modewise emission factors are presented. TREFACT, a computer program designed to calculate motor vehicle emission factors, is described. Emission factors for diesel and electric railroad locomotives are presented and discussed. Aircraft emissions are described in the context of total airport emissions. Emission factors for both inboard- and outboard-powered waterborne vessels are presented. (auth)

28886 (JINR-P4-7738) GENERALIZATION OF LIMITING RATIOS FOR SOME MODEL SYSTEMS. Lapushkin, S. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

Ratios between thermodynamic limits of the free energies evaluated for the model and approximation Hamiltonians are shown to be employed both for the negative and positive interactions. (auth)

28887 (UH-235-P-9-12) PHOTOELECTRIC EMISSION FROM THIN FILMS IN THE VACUUM ULTRAVIOLET REGION. Annual Progress Report, 1 March 1973–28 February 1974. Pong, W. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). 1 Mar 1974. Contract AT(04-3)-235. 54p. Dep. NTIS $4.75.

Research on the location of the density-of-states structure in the core states as well as in the valence and conduction bands of cesium halides is summarized. A list of publications is included. (JFP)

28888 (WASH-1174-73) NUCLEAR INDUSTRY, 1973. (USAEC, Washington, D. C.). 1973. 115p. Dep. NTIS $7.75.

A review of current industrial capabilities in the nuclear field and developing nuclear-related opportunities is presented. The information is included in sections on nuclear power, reactors and components, nuclear fuel cycle, radioisotopes and radiation applications, applied energy technology, AEC regulatory activities, and assistance for industry. (JRD)

28889 (Y-IA-124) PLANNING AND ASSIGNING MAINTENANCE WORK. Harding, J. E. (Oak Ridge Y-12 Plant, Tenn. (USA)). [nd]. Contract W-7405-eng-26. 25p. Dep. NTIS $3.25.

28890 SURFACE AND VACUUM PHYSICS INDEX. Volume 8, No. 12, 1973. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 65p.

Chemistry

28891 (BARC-667) EXPERIMENTAL PROBLEMS IN MICROTHERMOGRAVIMETRY. Part I. Dharwadkar, S. R.; Deshpande, V. V.; Karkhanavala, M. D. (Bhabha Atomic Research Centre, Bombay (India). Chemistry Div.). 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

A description is given of the design, construction, and operation of an automatic recording microthermobalance system for temperatures up to 1000°C, at 1 μg sensitivity (readability better than 0.5 μg) in static air at one atmosphere pressure. The system was built incorporating a Sartorius model 4102 electric microbalance, but the design is such that it could be adapted to accommodate any other commercial electric microbalance. (auth)

28892 (CEA-R-4516) FORECASTING OF THERMODYNAMIC PROPERTIES OF SOLUTION FOR NONPOLAR MOLECULES IN AQUEOUS SALT SOLUTIONS AND IN AQUEOUS ORGANIC SOLUTIONS. Feillolay, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Feb 1974. 74p. (In French). Dep. NTIS (U. S. Sales Only) $5.75.

Thesis. Submitted to Paris Univ. (France).

The scaled particle theory has been used rather successfully to predict the values of thermodynamic properties of solution for nonpolar molecules. Two very important parameters have been used in the equations of the scaled particle theory: the hard sphere diameter of the solute and the closeness of the solvent (closeness in which the diameters of the hard sphere particles forming the solvant are taken into account). With non-polar solutes, a correlation exists between calculated and experimental values of: free enthalpy of solution–enthalpy of solution–molar heat capacity change for the solution process. The fit between calculated and experimental values is only more qualitative than quantitative. However the variation of thermodynamic properties with the temperature and the modality is consistent with the variation, calculated according to the scaled particle theory. (auth)

28893 (COO-2191-1) SPECIFIC SORPTION OF COBALT BY VERMICULITE. Final Report, February 1, 1972–June 30, 1973. Reynolds, R. C. Jr. (Dartmouth Coll., Hanover, N. H. (USA). Dept. of Earth Sciences). 1973. Contract AT(11-1)-2191. 27p. Dep. NTIS $3.50.

Cobalt sorption on vermiculite was studied by equilibrating suspensions of clay with solutions of calcium, sodium, and magnesium acetate to which were added reagent-grade cobalt spiked with ^{60}Co. A sorption model was developed from these data that is drawn from conventional chemical theory. (LK)

Life Sciences

28894 (CEA-CONF-2435) METHOD OF STATISTICAL EXPLOITATION OF BIOMEDICAL DATA. Doche, C.; Max, J.; Caillot, P.; Garrel, S. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 14 May 1973. 19p. (In French). (CONF-730473-2). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting of biomedical electronics; Grenoble, France (13 Apr 1973).

A method for the statistical exploitation of biomedical data developed during the study of the latency times in motor and phonatory circuits in man is described. The principle of the multivaried analysis and the working hypothesis are outlined. The application of the results of the multivaried analysis to the judging of the efficiency of the parametering are reported. The adjusting of an individual with respect to a class of normal subjects and estimation of the weight of each parameter in this adjusting are discussed. The possibilities of using this statistical method for a systematic clinical exploitation are considered. (JSR)

28895 (CEA-CONF-2481) STAINING OF INTRACELLULAR GLYCOPROTEINS. Rambourg, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1973. 9p. (CONF-730679-1). Dep. NTIS (U. S. Sales Only) $3.00.

From international symposium on electron microscopy and cytochemistry; Drienerlo, Netherlands (25 Jun 1973).

28896 (CEA-CONF-2482) TRANSPORT OF MACROMOLECULES IN NERVE CELLS. Droz, B.; Di Giamberardino, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Biologie). [nd]. 18p. (CONF-730683-1). Dep. NTIS (U. S. Sales Only) $4.00.

From 2nd International Symposium on Cytopharacology of Secretion and Advanced Study Institute; Venice-Milan, Italy (17 Jun 1973).

28897 (CEA-CONF-2485) MORPHOLOGICAL ASPECTS OF PROTEIN SYNTHESIS. Droz, B.; Pisam, M.; Chretien, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1973. 29p. (CONF-730585-1). Dep. NTIS (U. S. Sales Only) $3.50.

From 6th Karolinska-OMS symposium on protein synthesis in reproductive tissue; Geneva, Switzerland (21 May 1973).

28898 (CEA-CONF-2487) MEASUREMENTS OF POLLUTION IN THE LOWER LAYERS OF THE ATMOSPHERE. Perroud, P.; Sylvestre-Baron, M.; Pleyber, G.; Perilhon, P.; Faivre-Pierret, R.; Closson, A.; Nicotra, C. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Jun 1973. 23p. (In French). (CONF-731060-1). Dep. NTIS (U. S. Sales Only) $3.25.

From meeting of anti-pollution techniques; Grenoble, France (2 Oct 1973).

The measurement of the meteorological parameters and the sampling of pollutants in the lower levels of the atmosphere were made by the use of captive balloons. A 550 m^3 airship filled with hydrogen was used with apparatus distributed along the anchor cable up to a height of 1,200 m. The meteorological probes used to measure the pressure, temperature, humidity, and wind velocity and to transmit them to the ground are described. The apparatus for air sampling and the chemical analytical methods are described. The results obtained are reported. This experiment made it possible to prove the relations existing between temperature inversion regions and pollution levels. The results show that under the temperature emission layers the profiles for the diffusion of SO_2, Cl_2, and organic pollutants are sharply different. (tr-auth)

28899 (CEA-CONF-2491) USE OF CAPTIVE BALLOONS FOR THE STUDY OF THE POLLUTION IN THE LOWER LAYERS OF THE ATMOSPHERE. Perroud, P.; Pleyber, G.; Sylvestre-Baron, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38

(France)). Sep 1973. 15p. (In French). (CONF-731138-1). Dep. NTIS (U. S. Sales Only) $3.00.

From AERALL colloquim; Paris, France (12 Nov 1973).

The sampling of pollutants is made with the aid of devices suspended to the anchor cable of a captive balloon. A radiosonde gives the vertical profile of the pressure, the temperature, and the humidity of the air and the vertical profile of the wind velocity. The start-up of the device is described. Some results are given which show the influence of a temperature inversion layer on the diffusion of certain pollutants. (tr-auth)

28900 (COO-2046-1) DIATOMS IN LAKES AND LAKE SEDIMENTS AS AN INDEX TO ENVIRONMENT. Final Report, Part 1. Diatom Stratigraphy and Human Settlement in Minnesota. Bradbury, J. P. (Minnesota Univ., Minneapolis (USA)). 1972. Contract AT(11-1)-2046. 91p. Dep. NTIS $6.75.

Fossil diatom assemblages in short cores of lake sediment from nine lacustrine environments (7 lakes) in Minnesota and South Dakota show the reaction of freshwater diatoms to limnologic changes associated with enrichment following Euro-American settlement. The time of settlement is stratigraphically determined by a rise in the proportion of Ambrosia (ragweed) pollen and in cases by other sediment characteristics. Changes in the diatom stratigraphy are interpreted in the context of local settlement history and its probable limnologic effect. As lakes become increasingly enriched with nutrients, the summer diatom plankton is replaced by blue-green algae, which, however, have no fossil record. The stratigraphic record is dominated instead by late-winter and spring diatoms, which also prosper in the nutrient-rich water. There are several variations on this theme, depending on the initial trophic state of the lake and other limnologic characteristics, but overall, the diatom stratigraphy of a lake is an effective way to measure man's impact on the lake ecosystem. (auth)

28901 (COO-2046-2) DIATOMS IN LAKES AND LAKE SEDIMENTS AS AN INDEX TO ENVIRONMENT. Final Report, Part 2. A Study of Phytoplankton Distribution, Lake Classification, and Trophic Indicators in Minnesota Lakes. Tarapchak, S. J. (Minnesota Univ., Minneapolis (USA)). 1972. Contract AT(11-1)-2046. 231p. Dep. NTIS $13.75.

This study was designed to investigate patterns of phytoplankton distribution, to contrast schemes of lake classification based on chemical and biologic criteria, and to evaluate properties of net phytoplankton, whole-water communities, and diatom assemblages as indicators of trophic state. The number of net taxa, desmids, and the compound quotient is correlated with the trophic gradient, but diatom ratios and the diversity of these assemblages are not so correlated. Conversely, the standing crop of phytoplankton and species diversity in whole-water samples exhibit statistically significant correlations with regional gradient parameters. Typological studies reveal that lake groupings based on different sets of variables are dissimilar in size, composition, and location, especially those that involve biologic variables. Algal properties that exhibit distinct trophic preferences are the numbers of net taxa and desmids, standing crop, and species number of whole-water communities. Desmids, chrysophytes, diatoms, and blue-green algae contain taxa that are indicators of oligotrophy and mesotrophy. (auth)

28902 (COO-3026-6) BASIC STUDIES OF STEROID HORMONE METABOLISM. Comprehensive Progress Report, May 2, 1971–January 31, 1974. Gut, M. (Worcester Foundation for Experimental Biology, Shrewsbury, Mass. (USA)). 1 Feb 1974. Contract AT(11-1)-3026. 17p. Dep. NTIS $4.00.

28903 (COO-3279-6) ECOLOGY OF THE PLANKTON OF THE CHESAPEAKE BAY ESTUARY. Progress Report, 1 September 1972–30 June 1973. Taylor, W. R. (Johns Hopkins Univ., Baltimore, Md. (USA)). 1973. Contract AT(11-1)-3279. 128p. Dep. NTIS $9.50.

28904 (COO-3282-43) GENETIC LOAD IN AMERICAN GENETIC ISOLATES. Final Report, April 1966–July 31, 1972. McKusick, V. A. (Johns Hopkins Univ., Baltimore, Md. (USA). School of Medicine). 1973. Contract AT(11-1)-3282. 20p. Dep. NTIS $4.00.

28905 (COO-3515-8) ROLE OF THE CARRIER IN ANTIBODY FORMATION. Final Report. Plescia, O. J. (Rutgers–the State Univ., New Brunswick, N. J. (USA). Inst. of Microbiology). 1973. Contract AT(11-1)-3515. 15p. (NYO-3707-8). Dep. NTIS $3.00.

The stimulus for this research, concerned with the role of the carrier in antibody formation, was the finding that polyancons such as nucleic acids could be converted into effective immunogens by coupling them to the basic protein methylated bovine serum albumin. This suggested the hypothesis that antibody formation is initiated by the reaction of antigen with mediator cells through carrier groups of the antigen. (auth)

28906 (ORNL-TM-4531) REVISED BERYLLIUM CONTROL PROGRAM FOR MSRE. Bolton, N. E.; Whitson, T. C. (Oak Ridge National Lab., Tenn. (USA)). 8 Mar 1974. Contract W-7405-eng-26. 17p. Dep. NTIS $3.00.

28907 (ORNL-UR-115) ALTERNATIVE METHODOLOGY FOR THE STUDY OF MIGRATION. Ritchey, P. N. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 27p. Dep. NTIS $3.50.

28908 (ORO-4465-1) PRODUCTION, PURIFICATION, AND ASSAY OF THROMBOPOIETIN. Progress Report, June 1, 1973–May 31, 1974. McDonald, T. P. (Tennessee Univ., Knoxville (USA). Memorial Research Center and Hospital). 1974. Contract AT(40-1)-4465. 18p. Dep. NTIS $3.00.

28909 (UCRL-51490) CYFILE: A SYSTEM OF SELF-EXPLANATORY MASTER FILES. Bogart, E.; Stedinger, J. R.; Mayall, B. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Nov 1973. Contract W-7405-eng-48. 25p. Dep. NTIS $4.00.

The CYFILE system is a set of file-handling routines and programs that create, edit, process, and retrieve self-explanatory master files. The system was written to facilitate statistical and graphical analysis of human chromosomes, but it was designed also to be generally applicable to any data base used for statistical analysis. The files created by the system contain alphameric identifiers, similar to FORTRAN names, that reference and label both descriptive variables and measurement variables in the file; these variable names are used by the statistical and graphical programs to obtain data and information from the files, so that the transfer of data becomes completely independent of the exact format or contents of the files. The CYFILE system also allows a large amount of preprocessing of the master files, using a language of commands that is available to all programs. The preprocessing may scale or transform values, select or delete particular subsets of the file, or perform conditional modifications of the data. The preprocessing capability, together with the flexibility conferred by self-explanatory files, has made the system powerful and versatile in its applications to human chromosome analysis. (auth)

28910 (UR-3490-390) COMPARTMENTALIZATION OF FLUIDS IN BONE. Neuman, W. F. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1973. Contract AT(11-1)-3490. 10p. (CONF-730989-1). Dep. NTIS $3.00.

From international colloquium on the physical chemistry and crystallography of apatites of biological interest; Paris, France (10 Sep 1973).

28911 (UR-3490-418) BEHAVIORAL ASSESSMENT OF LEAD INTOXICATION. Barocas, R.; Weiss, B. (Rochester Univ., N. Y. (USA)). 1973. 14p. (CONF-731062-1). Dep. NTIS $3.00.

From environmental health sciences symposium; Raleigh, North Carolina, USA (2 Oct 1973).

Materials

28912 (BNL-18428) SIMPLE SHELL MODEL AND INTERATOMIC FORCES IN IONIC CRYSTALS AND MOLECULES. Welch, D. O.; Dienes, G. J. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 7p. (CONF-730956-3). Dep. NTIS $3.00.

From Battelle colloquium on defects in oxides; Columbus, Ohio, USA (17 Sep 1973).

The usefulness of the shell model approach for defect calculations in oxides is illustrated by the calculation energies of Schottky and Frenkel defects in Al_2O_3, a material which has a polarization catastrophe even in the perfect crystal. (It was found in this calculation that aluminum Frenkel defects are energetically favored.) (auth)

28913 (CONF-731118-3) ANISOTROPIC THERMAL EXPANSION AND COMPRESSIBILITY OF BLACK PHOSPHORUS. Riedner, R. J.; Srinivasa, S. R.; Cartz, L.; Worlton, T. G.; Klinger, R.; Beyerlein, R. (Argonne National Lab., Ill. (USA)). [nd]. 14p. Dep. NTIS $3.00.

From international symposium on thermal expansion of solids; Lake of the Ozarks, Missouri, USA (7 Nov 1973).

28914 (COO-3161-19) THEORY OF STRUCTURE AND DYNAMICS IN CONDENSED MATTER. Progress Report, 1 April 1973–31 March 1974. Krumhansl, J. A. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). Jan 1974. Contract AT(11-1)-3161. 7p. Dep. NTIS $3.00.

Work during the report period is summarized. Data and information are included from studies of the properties of disordered alloys and similar materials. Results are also included on the

macroscopic engineering properties of polycrystalline or otherwise heterogeneous materials, theory and interpretation of heat pulse experiments and second sound in crystals, theory of neutron scattering from solid helium, studies of mechanisms of structural phase transitions, and dynamics of classical quadrupole solids. (auth)

28915 (COO-3410-2) THERMODYNAMIC PROPERTIES OF SOLID SOLUTIONS AT HIGH TEMPERATURES. Muan, A. (Pennsylvania State Univ., University Park (USA)). 1973. Contract AT(11-1)-3410. 10p. Dep. NTIS $3.00.

The research carried out under this contract was concerned with the determination of thermodynamic properties of inorganic materials at high temperatures. Experimental methods were developed which permit accurate and reliable determination of activity-composition relations in solid solutions, and stabilities of end-member compounds. The data provide insight into the general laws governing the behavior of materials in high-temperature environments. The phases selected for the experimental studies include orthosilicates, metasilicates, oxides of periclase structure, spinels, and titanates. It has been shown that directions of conjugation lines between coexisting solid-solution phases provide a powerful tool for determining relative stabilities of end-member compounds and activity-composition relations of solid solutions. In general, oxide phases (including silicates and titanates) forming complete solid-solution series at high temperatures show less deviations from ideality in their activity-composition relations than do alloy systems. Deviations from ideality are particularly small for many solid solutions of relatively simple structures (e.g. oxides of periclase structure), whereas those of greater structural complexities (e.g. spinels) show larger deviations from ideality. (auth)

28916 (COO-3459-5) PRECIPITATION AND DISPERSION HARDENING IN MAGNESIUM-BASE ALLOYS. Annual Report. Stoloff, N. S. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). 2 Jan 1974. Contract AT(11-1)-3459. 22p. Dep. NTIS $3.25.

Activities in a program on the elevated temperature mechanical properties of a directionally solidified Mg–Al eutectic composite are summarized along with results of an investigation of fatigue in vanadium. The lamellar Mg–Al eutectic, consisting of a brittle $Mg_{17}Al_{12}$ matrix phase and an Mg–8%Al solid solution, undergoes a sharp transition from brittle to ductile fracture at 250°C. The tensile strength of the alloy is half that in compression between 200 and 350°C, owing partly to the development of twinning in tension. A peak in strength in both tension and compression is noted as a function of growth speed. This peak is attributed to a change in fault density of the eutectic with growth speed. The influence of temperature on the properties of the composite is shown to arise primarily from changes in the resistance to plastic flow of the $Mg_{17}Al_{12}$ intermetallic phase. The program to study fatigue in vanadium has consisted of design of an environmental chamber for vacuum heat treating, or hydrogen charging, heat treatments to develop a 60-μ grain size, and fatigue specimen and grip design. Preliminary high cycle fatigue data in tension-tension loading, generated at room temperature, indicate a sharp endurance limit for unalloyed vanadium near a peak stress of 32,000 psi. (auth)

28917 (COO-3551-8) THERMODYNAMIC AND TRANSPORT PROPERTIES OF INTERSTITIAL HYDROGEN ISOTOPES IN PALLADIUM. Progress Report, April 1, 1973–December 15, 1973. Brown, J. S. (Vermont Univ., Burlington (USA)). 1973. Contract AT(11-1)-3551. 9p. Dep. NTIS $3.00.

Studies of electronic properties of solid and liquid transition metals Ni, Pd, and Pt and the properties of hydrides and deuterides of Pd are reported. The program is twofold in nature. The electronic properties of Pd in the solid and liquid states are being studied using p and d phase shifts of various muffin-tin potentials used to describe the conduction electron-ion core interaction. Of particular relevance is the study of resistivity and thermopower based on several theoretical calculations proposed recently for the liquid transition metals. In addition attempts to describe relative resistance anomalies in PdH_n and PdD_n and noble-Pd alloys of the form $A_xPd_{1-x}H_n$ in terms of changes in the d-state density and sd scattering and its competition with disorder scattering from the random array of H's are in progress. In addition continued studies of an interstitial ternary alloy CPA model are being pursued in order to elaborate further properties of the model. Ternary pair calculations are being completed and the inclusion of off-diagonal randomness in the model Hamiltonian is well under way. The treatment of electrical transport in ternary alloys using the CPA-diagrammatic model is being studied. (auth)

28918 (FRNC-TH-416) STUDY OF SPIN WAVES IN MnO AS A FUNCTION OF TEMPERATURE USING NEUTRONS. Pepy, G. (Paris-6 Univ., 75 (France)). 1972. 153p. (In French). Dep. NTIS (U. S. Sales Only) $9.75.

Thesis.

Neutron spectrometry enabled direct measurements to be made of the dispersion curves corresponding to spin waves in MnO for wave vectors in high symmetry directions. The magnon spectra were determined for temperatures ranging from the 4°K to those around the Neel temperature (119.75°K). It was possible to determine the magnetic structure (a type colinear magnetic structure). An improvement was made in the measurement of the onset of degeneracy of the magnon dispersion curves near to the origin. The direct measurement of spin waves at the sensitive points around the edge of the zone, where anisotropic deformation of the lattice occurs, led to the development of a model for the exchange integrals to which a dipole Hamiltonian is added. The various theories on the renormalization of the magnon energies are examined in order to discover those which best account for temperature effects in MnO (throughout the entire temperature range). A model derived from the Callen model appears to be the most suitable for the purpose. In addition, an attempt was made to experimentally demonstrate that the magnetic phase change occurring in MnO is of the first order with hysteresis. (FR)

28919 (K-P-4078) CORROSION RATES TO BE EXPECTED AT ZERO BLOWDOWN OF RECIRCULATING WATER. Fowlkes, C. C. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 1973. 19p. (CONF-740305-1). Dep. NTIS $3.00.

From national association of corrosion engineers program; Houston, Texas, USA (Mar 1974).

Tube samples have been obtained from the recirculating water test loop in K-602-1, ORGDP, after 1-, 2-, and 3-month exposures. The test loop was set up to evaluate the effects of zero blowdown and consequent high solids concentrations. Factors to be evaluated include the effects of such operation on heat transfer and corrosion. Two-foot lengths of copper and steel tubes, $\frac{3}{4}$ in. diameter × 0.067 in. wall, have been examined to evaluate the corrosion resulting from the test exposures. No adverse corrosion activity was noted on the recirculating water side of the copper tubes. Tube surfaces were smooth, and the longer exposure showed only slight evidence of etching and no tuberculation or pitting. Film formation was minimal. The expected multilayer deposit was seen and was about 0.005 in. thick in the first exposure, but it was much thinner and discontinuous following the 60-day exposure under more closely controlled water chemistry conditions. The steel tubes showed tuberculation and active pit formation. Pitting had progressed to a maximum depth of about 0.010 in. in the 0.067-in. tube wall during the initial 1-month exposure and to lesser depths under the modified conditions in subsequent 30-day tests. (auth)

28920 (LBL-2279) ISOTHERMAL STUDY OF BAINITIC AND MARTENSITIC TRANSFORMATIONS IN SOME LOW ALLOY STEELS USING A NEW MAGNETIC PERMEABILITY TECHNIQUE. Ericsson, C. E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1973. Contract W-7405-eng-48. 61p. Dep. NTIS $5.25.

Thesis.

The upper and lower bainitic hardenabilities were established for the commercial low alloy heat treatable steels AISI 4130, AISI 4140, D6AC and AMS 6416 (300-M). The kinetics of the bainitic reaction below the martensite start temperature (M_s) were studied and the martensite range temperatures were determined. The materials AISI 4130 and 300-M were austenitized at both 880°C and 1200°C and the effect of the austenitizing temperature on the upper bainitic hardenability was determined. A magnetic permeability technique was employed in this investigation to monitor the austenite transformations. Computational methods were developed to decode, analyze, and plot the austenite decomposition data. (auth)

28921 (LBL-2436) IMPURITIES IN HIGH-PURITY GERMANIUM AS DETERMINED BY FOURIER TRANSFORM SPECTROSCOPY. Haller, E. E.; Hansen, W. L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1973. Contract W-7405-eng-48. 19p. (CONF-731112-26). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

Fourier Transform Spectroscopy in the wave number range between 0 and 125/cm^1 (0 to 15 MeV) was used to determine the impurities producing shallow energy levels in high-purity germanium. The sensitivity of the method is sufficient to detect impurities at a concentration of 10^9/cm^3 with excellent signal-to-noise ratio and the selectivity (energy resolution) allows a clean separation of all shallow levels. So far only net-concentrations can be observed so that it was necessary to measure n- and p-type material separately. The elements boron, gallium and

indium appear to follow the expected segregation laws, while aluminum seems to be homogeneously distributed in the whole crystal. It has proven difficult to investigate n-type material due to the inability to produce low-noise electron-injecting contacts at the measuring temperatures (6 to 11°K). (auth)

28922 (MLM-2117) PROTOTYPE MOLDING OF MINIATURE COMPONENTS USING LOW COST MOLDS. Schurman, W. R. (Mound Lab., Miamisburg, Ohio (USA)). 16 Feb 1974. Contract AT-33-1-GEN-53. 16p. Dep. NTIS $4.00.

An economical method for injection molding of small prototype thermoplastic components was developed by Monsanto Research Corporation component development engineers at Mound Laboratory, Miamisburg, Ohio. Mold cavity inserts for two small injection molding machines were used to produce a variety of miniature thermoplastic components. One inch and one-half inch diamter mold inserts greatly reduced mold delivery time. This method of mold fabrication fulfills a need for low cost, low volume, small components when required in the development of products. Twelve different types of thermoplastics were successfully molded with the insert molds. A variety of small components with various shapes and cross sectional designs were successfully molded from thermoplastic injection moldable resins. (auth)

28923 (ORNL-tr-2748) NITROGEN SOLUBILITY IN AUSTENITIC CHROME–NICKEL STEELS. Bungardt, K.; Laddach, H.; Lennartz, G. Translated by R. Gregg Mansfield from Dew Tech. Ber.; 12: No. 2, 134-154(1972). 36p. Dep. NTIS $4.00.

The precipitates and process of precipitation in chrome-nickel steels supersaturated with nitrogen as a function of temperature, annealing time, and alloy composition were studied. Identification of separated phases, solubility of nitrogen as a function of alloy composition and temperature, and effect of precipitates on mechanical properties are also discussed. (auth)

28924 (ORNL-tr-2754) TEN YEARS OF AUSTENITIC STEELS IN BOILER OPERATION. Ruttman, W.; Brunzel, N. Translated by R. G. Mansfield from Mitt. Ver. Grosskesselbesitzer; 80: 310-326(1962). 29p. Dep. NTIS $3.50.

28925 (ORO-3897-3) PROGRAM FOR THE INVESTIGATION OF METALS AND ALLOYS. Final Report, March 1, 1969–February 28, 1973. Roberts, L. D. (North Carolina Univ., Chapel Hill (USA)). 1973. Contract AT(40-1)-3897. 59p. Dep. NTIS $5.00.

Metals and alloys were investigated through the use of a number of closely correlated experimental and theoretical methods. The work was directed toward gaining more complete information about the alloy wave function in the inner, or core, region of the atoms; the forces binding the alloy atoms; and toward obtaining a comprehensive theoretical description of some aspects of the work in terms of a pseudo potential treatment. These studies were conducted using Mössbauer effect measurements, x-ray chemical shift measurements, electrical resistance and magnetic studies including Kondo effect measurements at high pressures and low temperatures, and pseudo potential calculations. Studies have been made predominantly for the Mössbauer element, Au, as the pure metal, and in alloys with other metals. (auth)

28926 (SLA-73-5695) DETERMINATION OF EFFECTIVE THERMAL DIFFUSIVITY FOR A TWO-LAYER COMPOSITE LAMINATE. Schimmel, W. P. Jr.; Donaldson, A. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 11p. (CONF-731106-4). Dep. NTIS $3.00.

From 13th international conference on thermal conductivity; Lake Ozark, Missouri, USA (5 Nov 1973).

The problem of thermal conduction in a two-layer composite was investigated by representing the composite as a single layer with an effective thermal diffusivity. In the special case considered, the response of the adiabatic rear surface of a slab subjected to a step change in temperature at the front surface was determined. An expression was derived for the effective diffusivity which gives excellent agreement with an exact analysis for cases in which the relative error parameter is "small." If the parameter is large, for early times the effective analysis provides somewhat erroneous results but the agreement becomes acceptable at later times. For materials which are not as greatly different in thermal properties as the present two, the effective analysis should be even more appropriate. An obvious extension of the work is the case of more than two layers. It is not anticipated that any particular difficulty will arise in extending the method to multi-layer problems except for the complexity of manipulation. In addition, the case of constant surface flux and convective or radiative type boundary conditions should also be examined. (auth)

28927 (SLA-74-53) EVALUATION OF THREE COMMERCIAL-GRADE NICKEL ALLOYS FOR ELECTRICAL CONTACTS IN A DECELERATION SWITCH. Cuthrell, R. E.; Tipping, D. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1974. Contract AT(29-1)-789. 13p. Dep. NTIS $3.00.

Contact resistance data for three commercial-grade nickel alloys are presented. These data were obtained under stationary and wiping conditions for the metals exposed to atmospheric contaminants under accelerated oxidizing conditions. The results indicate that these nickel alloys are suitable inexpensive substitutes for precious metal electrical contact materials in a deceleration switch. However, only one of the two switch elements should be hardened. (auth)

28928 (SLA-74-5117) ELECTROOPTIC CERAMIC MATERIALS AND DEVICES. Land, C. E.; Smith, W. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 10p. (CONF-740404-1). Dep. NTIS $3.00.

From region 6 conference; Albuquerque, New Mexico, USA (24 Apr 1974).

An electrooptic ceramic is a transparent or partially transparent polycrystalline ferroelectric material. Electrooptic ceramics investigated thus far belong to the lead zirconate titanate $Pb(Zr,Ti)O_3$ solid solution system. By far the most useful electrooptic materials in this system are the lanthanum-modified $(Pb,La)(Zr,Ti)O_3$ ceramics. Electrooptic effects in these ceramics are being considered for a number of device applications including spectral and variable density filters, polarization switches, light shutters, page composers for holographic memories, information and image storage devices, and various types of displays. This paper briefly describes the electrooptic effects in ceramics and discusses their device applications. (auth)

28929 (SLL-73-300) STRESS WAVE GENERATION IN POROUS COPPER. Ng, R. (Sandia Labs., Livermore, Calif. (USA)). Feb 1974. Contract AT(29-1)-789. 29p. Dep. NTIS $3.50.

In early experiments to determine the response of porous materials to a single-pulse energy deposition, plots of stress versus time at the sample back showed an unexpected double-peak contour for several materials. In a series of electron beam experiments on porous copper, the present study confirms empirically the existence of the double-pulse structure. Results of data taken at five fluence levels show the generation and growth of the double pulse as a function of fluence, the second pulse originating at the fluence level where vaporization begins and growing as the level is raised. An energy-dependent $P-\alpha$ model modified and used with a WONDY analysis explains the experimental results and is in good agreement with them. (auth)

28930 (UCID-16439) PARTICIPATION OF LLL IN JSEXP: PERFORMANCE OF NON-IDEAL HE. Finger, M.; Lee, E.; Helm, F.; Cheung, H.; Miller, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Dec 1973. Contract W-7405-eng-48. 32p. Dep. NTIS $3.75.

A detonation model is developed and tested for alternative (composite) explosive materials. (DLC)

28931 (UCRL-51497) FLASH EVAPORATION OF PERMALLOY FILMS. Condas, G. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Dec 1973. Contract W-7405-eng-48. 102p. Dep. NTIS $5.45.

Thesis. Submitted to Univ. of Santa Clara, CA.

Flash evaporation was studied and analyzed with particular application to permalloy. As a consequence, a flash evaporation technique was developed for the production of high-purity, unfractioned permalloy films with good magnetic properties. A high boat temperature was found to be necessary, to prevent fractionation of the nickel and iron in the production of the vertically deposited films. Low water vapor content was also found to be necessary in the residual gas of the vacuum system, to prevent the refractory metal of the boat from appearing in the deposited films. (auth)

Physics

28932 (CEA-CONF-2499) TWO REGIMES OF A SPRAY COLUMN IN COUNTERCURRENT FLOW. Lackme, C. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). [nd]. 20p. (CONF-730803-6). American Inst. of Chemical Engrs., New York $1.00.

From national heat transfer conference; Atlanta, Georgia, USA (5 Aug 1973).

28933 (COO-2155-1) BIOMEDICAL ENGINEERING SUPPORT. Quarterly Progress Report, June 15, 1971–September 15, 1971. Kolff, W. J.; Donovan, F. M. Jr. (Utah Univ., Salt Lake City (USA). Dept. of Surgery). 11 Oct 1971. Contract AT(11-1)-2155. 16p. Dep. NTIS $3.00.

A daily power profile for the artificial heart has been determined from the literature and equipment and instrumentation has been assembled for measuring the efficiencies and power losses in the Kwan-Gett artificial heart. (auth)

28934 (COO-2155-2) BIOMEDICAL ENGINEERING SUPPORT. Quarterly Progress Report, September 15, 1971–December 15, 1971. Kolff, W. J.; Donovan, F. M. Jr. (Utah Univ., Salt Lake City (USA). Dept. of Surgery). 16 Dec 1971. Contract AT(11-1)-2155. 27p. Dep. NTIS $3.50.

The power input to the air drive line, input to the air chamber, input to the pumping diaphragm and output from the Kwan-Gett artificial heart has been measured at different atrial pressures with a constant frequency of 120 beats per minute and constant mean arterial pressure of 100 mm Hg. These measurements were made in vitro. The various efficiencies, cardiac outputs and pressures corresponding to the power measurements were also determined. (auth)

28935 (EUR-5067) 14TH 1972 METEOROLOGICAL YEARBOOK. Bollini, G.; Gandino, C. (Commission of the European Communities, Luxembourg; Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Feb 1974. 67p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.50.

After a short description of the methods for measuring and elaborating atmospheric phenomena, many tables and graphics for the meteorological year 1972 are reported with english titles. With the Observatory's data, temperature and relative humidity measurements at screen No. 4, 45 meters lower, the flow of the "Novellino" brook and 4 tables with the stability category are added. (auth)

28936 (ITF-73-110-E) BOGOLYUBOV'S R-OPERATION FOR LOCAL INTERACTIONS. Shcherbina, V. A.; Gordevskii, V. D.; Uvarov, O. V.; Chudinovich, I. Yu. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 18p. Dep. NTIS (U.S. Sales Only) $3.00.

Parametric representations are constructed for the finite parts of the Feynman amplitudes corresponding to the renormalized perturbation series for the S-matrix. These representations are obtained as limiting values for the Feynman amplitudes in spaces with indefinite metric, so the unitarity and causality of the S-matrix can be verified in all the orders of perturbation theory. (auth)

28937 (ITF-73-125-P) EXCITON–PHOTON INTERACTION AND THE OPTICAL SPECTRUM OF ABSORPTION OF MOLECULAR CRYSTALS. Eremko, A. A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The Green's function method is used to investigate the shape of the exciton line of light absorption for an arbitrary strength of exciton-phonon interaction and at temperatures different from zero. The Hamiltonian takes into account the interaction of electron excitation with all the branches of normal lattice vibrations. It is shown that the absorption may be both a purely exciton one and localized. The criterion of temperatures at which the absorption has localized character is obtained. (auth)

28938 (ITF-73-135-P) THERMODYNAMIC PROPERTIES OF THE DEGENERATE ELECTRON GAS AT THE METALLIC DENSITIES. Petrashko, R. N. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 28p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The pair correlation function of the degenerate electron gas at metallic densities derived in previous papers is used for investigation of the conditions of the thermodynamic stability of electron gas and of the cohesive energy of the alkali metals. (auth)

28939 (ITF-73-136-P) DIAGRAMMATIC TECHNIQUE FOR THE HUBBARD OPERATORS AND ITS APPLICATION IN THE THEORY OF MAGNETISM. Stasyuk, I. V.; Slobodyan, P. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 30p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The diagrammatic technique for the Hubbard operators on the base of the generalized Wick's theorem and cumulant expansions for averages of their products is being proposed. The correlation and Green's functions in the Anderson model describing the behavior of the magnetic impurity in an nonmagnetic host metal are being calculated by means of this technique. The diagrammatic expansions for the pair correlation of d-electrons are analyzed, logarithm terms giving the main contribution are deduced. In the case of infinitely large correlation energy /A/ of d-electrons on the impurity atom, the diagrams for the vertex part are summarized in so-called "parquet" approximation. The singularities of the vertex-part indicate the possibility of a "quasi-bound" state of conduction electrons with impurity d-electrons. The diagrammatic expansions in the case of infinite A are also analyzed. It is shown, that in the symmetrical case, when $2/Ed - \mu/ + A = 0$, the compensation of logarithm terms is possible, i.e., the Kondo effect is absent. (auth)

28940 (JINR-E4-7640) PHASE FLUCTUATIONS AND LINEWIDTHS IN A SOLID STATE ANTI-STOKES RAMAN OSCILLATOR. Welsch, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 13p. Dep. NTIS (U.S. Sales Only) $3.00.

By using quantum mechanical Langevin equations, the linewidths of Stokes and anti-Stokes modes are calculated as functions of damping, pumping, and detuning. With respect to the ratio of Stokes to anti-Stokes damping, in general, a stable behavior of the oscillator is found. In dependence on detuning, some special regions are expected to lead to very small linewidths. (auth)

28941 (LA-5452) METAL ATOM OXIDATION LASERS. Rice, W. W.; Beattie, W. H.; DeKoker, J. G.; Fradkin, D. B.; Bird, P. F.; Jensen, R. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1974. Contract W-7405-eng-36. 99p. Dep. NTIS $5.45.

Exploding wire and film techniques for metal atom production have been extraordinarily successful in producing laser action from exothermic exchange reactions of the form $M + XY \rightarrow MX^* + Y$. To date, lasing has been observed from CO, TiO, VO, ZrO, MoO, TaO, WO, UO, LiF, CF, MgF, AlF, TiF, VF, FeF, NiF, CuF, ZnF, ZrF, MoF, AgF, TaF, WF, PtF, AuF, and UF molecules in the ir region of the spectrum. Explosively shocked metal structures have been used to provide jets of metal atoms that have also produced lasing from MgF. This result corroborates the assertion that the lasing from the exploding wire event is chemical in origin, and it provides an alternative technique for possible future development. Very preliminary work on cw metal jets was performed. It was possible to operate a sodium nozzle into a flow of fluorine gas for 40 min using a high-thermal-conductivity structure to supply sodium vapor to the nozzle plenum. A larger multinozzle system is now being assembled. Future work in metal atom oxidation lasers is expected to produce electronic transition lasers and much new data on basic chemical kinetics. The important possible applications of this class of lasers are development of low-gain systems operating on triplet → singlet transitions and capable of very large energy storage for pulse laser applications, and development of high-efficiency cw lasers in the infrared. (auth)

28942 (LBL-1418) COMPUTER PROGRAM TO CALCULATE LOW ENERGY ELECTRON DIFFRACTION INTENSITIES. Martin, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1972. Contract W-7405-eng-48. 115p. Dep. NTIS $7.75.

A detailed description is given of the multiple scattering low energy electron diffraction program. The mathematical models used to account for the inner potential and the inelastic damping of the scattered electron are described. The formalism for introducing the temperature dependence into the multiple scattering problem is discussed. The computer codes for calculating diffraction intensities are given. (MOW)

28943 (MLM-2089) SEMIAUTOMATED DATA COLLECTION FOR THE Q. C. ANALYSIS OF METALLOGRAPHIC PHOTOS OF LASER WELDED BRIDGEWIRES. Gress, A. V. Jr. (Mound Lab., Miamisburg, Ohio (USA)). 11 Mar 1974. Contract AT-33-1-GEN-53. 26p. Dep. NTIS $3.50.

The tests run on the free cursor digitizer have demonstrated the practicality and feasibility of the process. The recording of data for computer or calculator on either tape or cards can be readily accomplished. The cost of such a system is estimated at $18,000. (auth)

28944 (NP-19949) MEASUREMENT OF THE Au $K_{\alpha 1}$ X RAY CHEMICAL SHIFT BETWEEN Cu_3Au AND Au. Knoble, D. W. (North Carolina Univ., Chapel Hill (USA). Dept. of Physics and Astronomy). 1973. 142p.

Thesis.

The Au $K_{\alpha 1}$ x ray chemical shift between Cu_3Au and Au was measured to be $\Delta E_x = -35.4 \pm 6.1$ MeV with the Au $K_{\alpha 1}$ x ray from Cu_3Au of a lower energy than the $K_{\alpha 1}$ x ray from pure Au. The measurement was made using a 2 m bent crystal spectrometer. The $K_{\alpha 1}$ x ray chemical shift may be approximately described by a difference of matrix elements, $\Delta E_x = \langle \Psi' | V_{2P_{3/2}} - V_{1s_{1/2}} | \Psi' \rangle - \langle \Psi | V_{2P_{3/2}} - V_{1s_{1/2}} | \Psi \rangle$, where Ψ' describes the electron density in the alloy, Ψ describes the electron density in pure Au, and where $V_{2P_{3/2}}$ and $V_{1s_{1/2}}$ are the potentials due to the $2p^3/_2$ and $1s^1/_2$ charge distributions in Au. Ψ' and Ψ were estimated for Cu(Au) and Au, using wave functions derived in a Hartree-Dirac-Wigner-Seitz approximation, and using an approximate band theory. Within the approximations of this alloy model, information from the Friedel sum rule and the residual resistivity is used to estimate the Mössbauer isomer shift and the x ray chemical shift. The calculation of the Au $K_{\alpha 1}$ x ray

chemical shift between Cu_3Au and Au yields a value of 54.0 MeV. (auth)

28945 (ORNL-tr-2755) INFLUENCE OF THE STATE OF STRESS ON THE RUPTURE BEHAVIOR OF METALS. Schiller, H. Translated from Schweisstechnik (Berlin); 22: No. 11, 507-511 (1972). 13p. Dep. NTIS $3.00.

In order to formulate a relation reflecting the dependence of the lingitudinal fracture stress on the nature of the state of stress, it was necessary to consider various model concepts concerning the relationship between the yielding criterion, strain hardening law, and fracture behavior. It was demonstrated that a critical deformation work of the maximum tensile stress component is responsible for the occurrence of strain fractures under longitudinal rotation-symmetrical tensile stress states. This relationship could be formulated mathematically. On the basis of the formulated relation, uniaxial tensile, contraction-tensile and longitudinal compression, transverse compression tests were performed for confirmation. Materials C15, C35, and AlMg5 were used for the tests. The derived relationship was confirmed by the experimental studies. (auth)

28946 (SLA-73-5298) STUDY OF BASE PRESSURE IN LAMINAR HYPERSONIC FLOW: REENTRY FLIGHT EXPERIMENTS. Bulmer, B. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 20p. (CONF-740114-1). Dep. NTIS $3.00.

From 12th aerospace sciences meeting; Washington, District of Columbia, USA (30 Jan 1974).

28947 (SLA-73-5635) EFFECTS OF UNSYMMETRICAL STABILITY DERIVATIVE CHARACTERISTICS ON REENTRY VEHICLE TRIM ANGLE BEHAVIOR. Hodapp, A. E. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 38p. (CONF-740114-2). Dep. NTIS $4.00.

From 12th aerospace sciences meeting; Washington, District of Columbia, USA (30 Jan 1974).

A quasi-steady analytical theory is developed to investigate the effects that unsymmetrical stability derivative characteristics can have on the trim angle behavior of slender rolling reentry vehicles. For mass, aerodynamic and inertia asymmetries, the predicted trim angle behavior patterns are very unstable in comparison to the well-known patterns displayed by vehicles with symmetrical stability derivative characteristics. Near the resonances small asymmetries in the static moment slope characteristics are shown to cause large sometimes unbounded increases in trim magnification and jump discontinuities in windward meridian position. The analytically predicted trends are verified by six degree-of-freedom numerical simulations. (auth)

28948 (SLA-73-5926) DIGITAL CONTROL OF RANDOM VIBRATION TESTS USING A SIGMA V COMPUTER. Tebbs, J. D.; Hunter, N. F. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 8p. (CONF-740415-3). Dep. NTIS $4.00.

From twentieth annual technical meeting and equipment exposition of the Institute of Environmental Sciences; Washington, District of Columbia, USA (28 Apr 1974).

Digital control of random vibration tests at the Systems Environmental Testing Facilities in Area III, Sandia Laboratories, Albuquerque, New Mexico is described. A block diagram of the vibration system with digital control is shown. The Sigma V computer with its A-to-D converter, D-to-A converter, and FFT Processor replaces the traditional analog equalizer/analyzer in the feedback control loop. The highly specialized equalizer/analyzers that have been used in the past are, in general, difficult to set up and operate, expensive to maintain, and are prone to early obsolescence. The computer can provide greater frequency resolution (up to 512 filters) and dynamic range (greater than 80 db) and can be used efficiently to set up testing parameters from simple operator key-ins and can run the test without operator intervention. (auth)

28949 (SLA-74-8) MOTION OF SELF-PROPELLED PRESSURIZED VESSELS. Bennett, M. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1974. Contract AT(29-1)-789. 13p. Dep. NTIS $3.00.

The translational motion that results when the gaseous contents of a pressurized tank are rapidly discharged into the atmosphere is determined for perfect fluids with no heat transfer. (auth)

28950 (SLA-74-17) PANORAMIC CAMERA. Janney, I. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1974. Contract AT(29-1)-789. 47p. Dep. NTIS $4.50.

A wide angle camera with a long focal length lens is described. The camera produces a long narrow picture on standard 70 mm film to put it in the general classification of panoramic cameras. The camera was designed for a special purpose to meet requirements as part of a larger system. However, it can be operated separately for other applications. Details of operation are included in an appendix. (auth)

28951 (SLA-74-45) ESTIMATES FOR SHELL DEFLECTIONS OF REENTRY BODIES SUBJECTED TO LATERAL IMPULSE LOADS. Sagartz, M. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 12p. Dep. NTIS $3.00.

Formulas for the deflection of elastic rings and finite cylindrical shells with simply supported and clamped boundary conditions are derived for a cosine-distributed impulse over half their circumference. These formulas provide a criterion for the gap selection in magnetically driven flyer plate tests. (auth)

28952 (SLA-74-5161) DEVELOPMENT OF A LIGHTNING ARRESTOR CONNECTOR. Traeger, R. K. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 14p. (CONF-740503-1). Dep. NTIS $3.00.

From electronic components conference; Washington, District of Columbia, USA (May 1974).

A lightning arrestor connector was developed and evaluated. The design is based on an LJT connector with an air breakdown providing the arresting feature. The air breakdown is stimulated by rutile, a high dielectric constant insulator to provide adequately rapid breakdown of the air gap. The connector passed stringent environmental tests and performed satisfactorily at simulated lightning currents over 200,000 amperes. (auth)

28953 (UCRL-51464) COMPUTER EVALUATION OF LORAN-C ANTENNAS. Miller, E. K.; Deadrick, F. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Oct 1973. Contract W-7405-eng-48. 136p. Dep. NTIS $9.00.

Computer modeling techniques applied to a thin-wire electric field integral equation for the design and evaluation of several U. S. Coast Guard Loran-C antennas are discussed and illustrated. Antenna input impedances and near electric fields are presented as functions of structure configuration, ground medium, ground screen, and layered ground parameter variations. (auth)

28954 (UCRL-51474) LISBOURNE EXPERIMENTS: PROPAGATION OF HF RADIO WAVES THROUGH PERMAFROST ROCK. Lytle, J.; Laine, E.; Lager, D.; Okada, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Oct 1973. Contract W-7405-eng-48. 74p.

Experiments were conducted to determine the in situ relative dielectric constant ϵ_r and conductivity σ of hard rock in a permafrost region with respect to propagation of high-frequency radio waves. The experiments were performed in the Brooks Range in northern Alaska, a region which is underlain by permafrost. Because the hard rock at the experimental site is limestone of the Lisbourne group, these experiments were denoted as the "Lisborne experiments." Two holes were drilled about 600 ft deep and 550 ft apart. Measurements were made of transmission attenuation, transmission phase shift, four-probe mutual impedance, two-loop mutual impedance, dipole impedance, axial E-field decay off the end of a dipole, core samples, and downhole temperature. Probing was done on the surface, in a single hole, between surface and hole, and from hole to hole. Methods of excitation included cw, swept frequency, and pulse sources. Data were obtained over the frequency range of 20 Hz to 50 MHz. (auth)

28955 (UCRL-51479) MEASUREMENT OF EARTH MEDIUM ELECTRICAL CHARACTERISTICS: TECHNIQUES, RESULTS, AND APPLICATIONS. Lytle, R. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Nov 1973. Contract W-7405-Eng-48. 36p. Dep. NTIS $4.00.

An overview of measurement techniques, measurement results, and factors influencing the conductivity and dielectric constant of earth medium is given. Application of these measurement techniques to geophysical investigations is also discussed. (auth)

28956 (UCRL-51522) CRITICAL SHOCK INITIATION ENERGY OF PBX-9404, A NEW APPROACH. Green, L. G.; Nidick, E. J. Jr.; Walker, F. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jan 1974. Contract W-7405-eng-48. 9p. Dep. NTIS $4.00.

The critical initiation energy of PBX-9404 was recalculated from thin-foil initiation data by a method that depends upon the lengthening of the excess transit time as the initiation foil kinetic energy approaches the critical initiation energy. The method was then used to calculate the critical initiation energy from some thin-foil initiation experiments on recently manufactured PBX-9404, hot pressed to a density of 1.842 Mg/m^3. The critical energy value for the recently manufactured PBX-9404 is 644 ± 17 kJ/m^2 compared to 595 ± 46 kJ/m^2 calculated for the older data. (auth)

28957 (UCRL-74848) TIME-DOMAIN COMPUTER MODELS OF THIN-WIRE ANTENNAS AND SCATTERERS. Landt, J. A.; Miller, E. K.; Deadrick, F. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1973. 16p. (CONF-730935-5). Dep. NTIS $3.00.

From EMP technical meeting; Kirtland AFB, New Mexico, USA (25 Sep 1973).

The transient responses of various thin-wire antennas and scatterers were studied through the numerical solution of a time-dependent electric field integral equation. The solution is set up as an initial value problem and proceeds via time stepping. This is a generally more efficient approach for determining the transient response of wire objects than frequency domain solutions which are Fourier transformed to obtain transient characteristics. The time-domain solutions have been verified by comparisons with other solutions for structures such as the linear dipole, circular ring, conical spiral, and V-dipole. In addition to providing wide-band frequency domain information via Fourier transformation, the time-domain solutions permit the temporal development of the currents and charges to be followed, which permits ready demonstration of reflections from junctions or ends of wires, the effects of loading, phase dispersion of the current waves as they travel along the structure, and structure resonances. The characteristics of several structures are considered with the aim of providing insight into their EMP response characteristics. Attention is devoted to methods of data presentation which efficiently utilize the large amount of information which the time domain solution yields and to exploiting this data for problems of practical interest. These studies show, for example, that a current saturation occurs when a long wire (in free space) is illuminated by a short pulse plane wave. Insight gathered from the time-domain solution of this problem has lead to a simple method of estimating the maximum current on the wire. (auth)

28958 (UCRL-74886) DISPERSION OF SST EXHAUST PLUMES IN THE STRATOSPHERE. Walton, J. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jan 1974. Contract W-7405-eng-48. 22p. (CONF-740106-3). Dep. NTIS $3.25.

From 1st special assembly of the International Association of Meterology and Atmospheric Physics; Melbourne, Australia (14 Jan 1974).

Certain characteristics of multi-dimensional coupled kinetics-transport codes preclude exploration of a wide range of the characteristic processes in the atmosphere. For this reason a parameterization of transport effects has been obtained for use in conjunction with a single box kinetics program developed at LLL. Using this coupled model a study of the sensitivity of O_3 destruction to transport and source parameters has been carried out to serve as a guide to specific problems of interest for study by the available multi-dimensional codes. (auth)

28959 (Y-1936) PHASE-SENSITIVE LVDT TRANSDUCER TESTING SYSTEM. Turner, P. C. (Oak Ridge Y-12 Plant, Tenn. (USA)). 4 Apr 1974. Contract W-7405-eng-26. 18p. Dep. NTIS $4.00.

A system has been developed to measure mechanical and electrical parameters of ultralinear [0.05% (full scale) nonlinearity] displacement transducers of the linear variable differential transformer (LVDT) type. From these measurements, transducer pretravel, over travel, maximum percent nonlinearity, null voltage, and half-range output voltage can be determined. The system measures transducer stylus position with a precision digital micrometer. Corresponding output/input voltage ratio (transfer ratio) data are measured using a phase-sensitive, AC bridge circuit. From these measurements the maximum percent nonlinearity of an LVDT transducer is determined with an accuracy of ±0.024% (full scale) for a 0.200-inch (5.08-mm) transducer. (auth)

28960 (Y-1939) INFLUENCE OF PRESSURE VARIATIONS ON THE FOCUS OF ELECTRON BEAMS USED FOR WELDING. Brandon, G. W. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). 11 Apr 1974. Contract W-7405-eng-26. 19p. Dep. NTIS $4.00.

An experimental study has shown that the variations in pressure typically experienced in an electron-beam welding chamber can significantly affect the focus of the electron beam, resulting in detectable variations in weld penetration and width. (auth)

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